UNIVERSITI TEKNOLOGI MARA
FINAL EXAMINATION

COURSE	:	**FUNDAMENTALS OF DATA STRUCTURES**
COURSE CODE	:	**CSC248**
EXAMINATION	:	**MARCH 2016**
TIME	:	**3 HOURS**

INSTRUCTIONS TO CANDIDATES

1. This question paper consists of two (2) parts : PART A (10 Questions)
   PART B (9 Questions)
2. Answer ALL questions from two (2) parts in the Answer Booklet. Start each answer on a new page.
3. Do not bring any material into the examination room unless permission is given by the invigilator.
4. Please check to make sure that this examination pack consists of :
   i) the Question Paper
   ii) an Answer Booklet – provided by the Faculty
5. Answer ALL questions in English

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

This question paper consists of 13 printed pages

PART A (15 MARKS)

1. An abstract data type consists of a collection of _____ together with a collection of _____.

   A. values, operations
   B. operations, values
   C. classes, attributes
   D. attributes, classes

2. _____ is a model of data structure that specifies the type of data stored, the operations supported on them and the types of parameters of the operations but not the implementation.

   A. Primitive data type
   B. Abstract data type
   C. Data stucture
   D. Sequential list

3. A _____ is a data structure that organizes data similar to a line in the supermarket, where the first one in line is the first one out.

   A. arrayList
   B. stacks
   C. tree
   D. queue

4. Which of the following methods of ArrayList class is used to obtain the current size of a list?

   A. size()
   B. length()
   C. index()
   D. capacity()

5. Which of the following is NOT a type of Linked List?

   A. Circular Linked List
   B. Doubly Linked List
   C. Singly Linked List
   D. Hybrid Linked List

6. Each node in a Linked List contains a minimum of two fields, one field is called data field to store data and another field is a _____.

A. pointer to a node
B. pointer to a class
C. pointer to an integer
D. pointer to a character

7. Which of the following is NOT related to the queue data structure?

A. A structure that is referred to as a first-in first-out data structure.
B. The insertion process is only allowed at the front.
C. The last element inserted into it will be the last element removed.
D. The modification process is done at the front of the data structure.

8. The method _____ is used to return the element at the top of a Stack.

A. `top()`
B. `front()`
C. `last()`
D. `peek()`

9. In a binary search tree, which traversal type would print the values in the nodes in a sorted order?

A. Preorder
B. Postorder
C. Inorder
D. None of the above

10. Which of the following statements about binary trees is **NOT** true?

A. Every binary tree has at least one node.
B. Every non-empty tree has exactly one root node.
C. Every node has at most two children.
D. Every non-root node has exactly one parent.

PART B (85 MARKS)

QUESTION 1

The following is a Java application using the `NumberApp` ADTs.

```
public class NumberApp
{
    public static void main (String[] args)
    {
        final int MAX = 5;
        String strnum;
        ArrayList numList = new ArrayList(100);

        for (int i = 0; i < MAX; i++)
        {
      strnum = JOptionPane.showInputDialog ("Input number : ");
      numList.add(i, strnum);
        }

        // ************************************

        Object obj;

        for (int j = 0; j <numList.size(); j++)
        {
            double num = Double.parseDouble
              (numList.get(j).toString());
            if ((num%3) == 0)
                obj = numList.set(j, "1000");
            else
            {
                obj = numList.remove(j);
                System.out.println ("Removed number is "
                                    +obj.toString());
            }
        }

        // ***********************************

    }//end of main
}//end of class
```

a) Show the output of the program if the following inputs are given:

```
2, 51, 7, 100, 85
```

(3 marks)

b) Draw a diagram of the sequential list at the lines marked **********.

(4 marks)

c) Write a Java code segment code to display the final data in `numList`

(1 mark)

QUESTION 2

A program to process the data of presenter will use the ArrayList data structure. For this purpose the `Presenter` and `ArrayList` ADTs are given as below:

```
public class Presenter
{
   private String name;     //presenter name
   private String affiliation; //presenter affiliation. Ex.UiTM
   private String paperId;     //Ex. ACME1001
   private boolean paymentStatus;       //true if paid

   public Presenter(String, String, String, boolean) {…}
   public String getPresenterName() {…}
   public String getAffiliation() {…}
   public String getPaperId() {…}
   public boolean getPaymentStatus() {…}
}//end of class Presenter

public class ArrayList
 {
   public int size() {…}
   public void add(Object) {…}
   public  Presenter get(int) {…}
   public Presenter remove(int) {…}
}//end of class ArrayList
```

Assuming the record of presenters have been inserted into a sequential object named `presenterList`. Write Java program segments to carry out the following tasks:

a) Copy the record of presenters from `presenterList` to a sequential list named `confirmedList`, otherwise if they are not paid, copy the records to `pendingList`. Display the number of presenters for both `confirmedList` and `pendingList`.

(4 marks)

b) Count and display the number and name of presenters from UiTM.

(5 marks)

QUESTION 3

A program to process the data of SUKSIS will use the LinkedList data structure. For this purpose the `SUKSIS` and `LinkedList` ADTs are given as below:

```
public class SUKSIS
{
    String name;
    char gender; //Female - F, Male - M
    double height;
    double weight;

    public SUKSIS(String n,char g,double h,double w) {...}
    public String getName() {...}
    public char getGender() {...}
    public double getHeight() {...}
    public double getWeight() {...}
    public boolean qualified() {...} //return true if student is
                                     //qualified to join SUKSIS.
                                    //Otherwise, return false.
  public String toString() {...}
}

public class LinkedList
{
  public void insertAtFront(Object insertItem) {...}
  public Object removeFromFront(){...}
  public boolean isEmpty() {...}
  public Object getFirst() {...}
  public Object getNext() {...}
}
```

The data has been inserted into a `LinkedList` object named `studentlist`. Write a JAVA program segment to solve the following problems.

a) Display the number of female students who are not qualified to join SUKSIS.

(4.5 marks)

b) Remove the qualified students from `studentlist` and move them to a new `LinkedList` named `juniorSquad`.

(Hint: Transfer all data from `studentlist` to a temporary list during the process and then transfer back to studentlist)

(5.5 marks)

QUESTION 4

The following are the ADTs of `StudentEvent`, `ListNode` and `LinkedList`.

```
public class StudentEvent
{
    private String eventName;    //Programming Contest
    private String organizer;    //COMPASS
    private String venue;        //Computer Lab
    private double budget;       //1500.00
    private boolean status;      //True: Event is approved or
                                 //False: Event is not approved

    public Event(String n, String o, String v,
                 double b, boolean s){}
    public String getEventName(){}
    public String getOrganizer(){}
    public String getVenue(){}
    public double getBudget(){}
    public boolean getStatus(){}
    public void displayEvent(){}
}

public class ListNode
{
   StudentEvent data;
   ListNode next;

   ListNode(StudentEvent object){}
   ListNode(StudentEvent object, ListNode nextNode){}
   StudentEvent getObject(){}
   ListNode getLink(){}
}

public class LinkedList
{
    private ListNode firstNode;
    private ListNode lastNode;
    private ListNode currNode; //used to traverse the list

    public LinkedList(String s){}
    public LinkedList(){}
}
```

A program is written to store the information of students' event at UiTM in a `LinkedList`. All classes will be used for this purpose. Write methods for class LinkedList to do the following:

a) Write method `insertBack()` to insert a data at the end of the `LinkedList`.

(4 marks)

b) Write method `deleteBack()` which deletes and returns the data at the end of the `LinkedList`.

(8 marks)

QUESTION 5

Consider the following method. Assume that `IntQueue` is an integer queue.

```
void fun(int n)
{
    IntQueue q = new IntQueue();
    q.enqueue(0);
    q.enqueue(1);
    for (int i = 0; i < n; i++)
    {
        int a = q.dequeue();
        int b = q.dequeue();
        q.enqueue(b);
        q.enqueue(a + b);
        print(a + " ");
    }
}
```

a) Trace the output of the method if the value of `n=7`. Draw the diagram of all queues involved in every iteration and show the final output.

(7 marks)

b) What does function `fun` do?

(1 mark)

QUESTION 6

The following are the ADTs of `ChaletOwner` and `Stack`:

```
public class ChaletOwner
{
    private String chaletName;
    private String chaletID;
    private double profit; //profit for a year
    private boolean citizenship; //true: Malaysian,
                                 //false: non-Malaysian

    public ChaletOwner(...){...}
    public String getChaletName(...){...}
    public String getChaletID(){...}
    public boolean getCitizenship(){...}
    public double getProfit(){...}
    public String toString(){...}
}
public class Stack
{
    public Stack();
    public void push(Object o){...}
    public Object pop(){...}
    public boolean isEmpty(){...}

}
```

Based on the above ADTs, write a program segment to solve the following problems. Assume that all the data of chalet owner is stored in a stack named `sChalet`.

a) Count the number of owners who are foreigners and earn a profit of more than a million.

(4 marks)

b) Search the details of owner based on ID that is keyed in by user.

(3 marks)

QUESTION 7

a) Convert the following expression to PREFIX and POSTFIX expressions:

A + B * (C $ D – E) $ (F + G * H) - I

(4 marks)

b) Show the diagram of the stack in the evaluation of the postfix expression below:

3 2 3 $ + 3 2 1 + * -

(4 marks)

QUESTION 8

Given the following input data:

61, 32, 77, 14, 27, 93, 69, 105, 81

Based on the input data above:

a) Draw the binary search tree. (3 marks)

b) Traverse the tree in preorder, inorder and postorder traversal. (6 marks)

c) What is the height of the tree in (a)? (1 mark)

QUESTION 9

A program to process the data of researcher will use the Binary Search Tree data structure. For this purpose the `Researcher`, `TreeNode` and `BSTResearcher` ADTs are given as below.

```
public class Researcher
{
      private String name;
      private String institution;
      private int id;
      private String field;
      private String status;

      public Researcher (String, String, int,String,String){…}

      public String getName() { … }
      public String getInstitution(){ …}
      public int getID(){ …}
      public String getField() {… }
      public String getStatus() {… }
      public String toString(){…} //return staff details

}

public class TreeNode
{
    TreeNode left;  // left node
    Researcher data;   // data for a Researcher
    TreeNode right; // right node


    //definition of other methods
}

public class BSTResearcher
{
    public BSTResearcher() {…}
   public void insert(Researcher rsch)
   public int countInstitution(Sring inst) {..}
    public void displayDetails() {…}

    // definition of other methods
}
```

The following table shows information about the researchers in the Faculty of Computer and Mathematical Sciences.

NAME	INSTITUTION	Identification (ID)	FIELD	STATUS
Din Hassan	UiTM	165	Parallel Computer	Passed
Amin Ismail	UUM	171	Hyper Forming Computer	Failed
Aliah Abu	USM	162	Data Mining	Passed
Halim Abu	UiTM	174	Big Data	Passed
Din Hassan	UiTM	165	Parallel Computer	Passed
Jessica Alba	UKM	163	Cloud Computing	Failed
Taib Ahmad	UPM	175	Knowledge Management	Failed
Musa Bakar	UIAM	153	Human Computer Interaction	Passed

a) Create a binary search tree according to researcher Identification.

(3 marks)

b) Write the definition for `countInstitution(String ins)` and its recursive method to count the number of researchers from the given institution.

(5 marks)

c) Write the definition for `displayDetails()` and its recursive method to find and display the name of researchers with passed status.

(5 marks)

END OF QUESTION PAPER