

BSc (Hons) Computing | ITB | EHNS-Year 1
Higher National Diploma in Software Engineering-21.1F

Programming Data structures and Algorithms-1

Time allowed: Three hours

15th December 2021 | 1PM-4PM

INSTRUCTIONS TO CANDIDATES

- This paper contains 5 questions. Answer ALL questions.

Question 1 (10 Marks)

- A. What is a data structure? Give an example for contiguous and non-contiguous data structure. (4 marks)
- B. Consider the integer array given below (6 marks)

int x[10]= {1, 6, 2, 3, 5, 4, 3, 9, 2, 4}

Considering the main program given below, implement the function **CountOddandEven(..)** to count the frequency of odd numbers and even numbers and display it.

```
int main()
```

```
{
```

```
    int x[10]= {8, 6, 2, 3, 5, 4, 3, 9, 2, 4};
```

```
    CountOddandEven (x,10); // parameters are array and the size of the array
```

```
    return 0;
```

```
}
```

Output: Odd Count=4

Even Count=6

Question 2 (20 Marks)

- a. Give 2 examples of applications for stack and queue (2 for each) data structure used in computer. (4 marks)
- b. Write the output for each line of the following program. Assume that enqueue(), dequeue(), front(), and size() functions are already implemented in a Queue ADT.

```
int main()
```

```
{
```

```
    enqueue(10)
```

```

        enqueue(15)
        enqueue(25)
        enqueue(10)
        dequeue()
        dequeue()
        front()
        enqueue(25)
        enqueue(10)
        dequeue()
        dequeue()
        size()
    }

```

(6 marks)

- c. Assume you are required to write a code for a complex calculator. The user must be able to enter any expression even with parenthesis (brackets). If the user enters parenthesis your program is should check whether parenthesis is balanced in the user's expression before trying to evaluate it.
- I) What would be the data structure you would use to check for balanced parenthesis? (2 marks)
 - II) Write two main functions/methods used in this data structure which is helpful to check whether parenthesis is balanced. (8 marks)

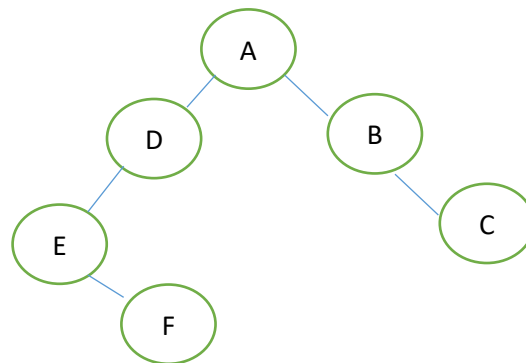
Question 3 (20 Marks)

- a) The linked list data structure is a dynamic data structure. How is it supported/given the dynamic nature? (2 marks)
- b) Illustrate a circular linked list with a suitable diagram. (3 marks)
- c) Write an algorithm to insert an element to the front of a doubly linked list. (7 marks)
- d) Write a program to insert marks of students with index numbers according to the given order into a single linked list. Your program should have the following components:
 - I) Linked list class and node structure.
 - II) Insert function to insert new records according to the given order. (8 marks)

Question 4 (30 Marks)

- A. Draw a binary search tree to store the following data elements. (4 marks).
Data : 100, 15, 25, 12, 8, 70, 10, 1
- B. State that the tree drawn above is AVL or Not AVL. Justify your answer. (3 marks).
- C. Write the in-order, pre-order & post-order traversal orders of the following Binary Tree.

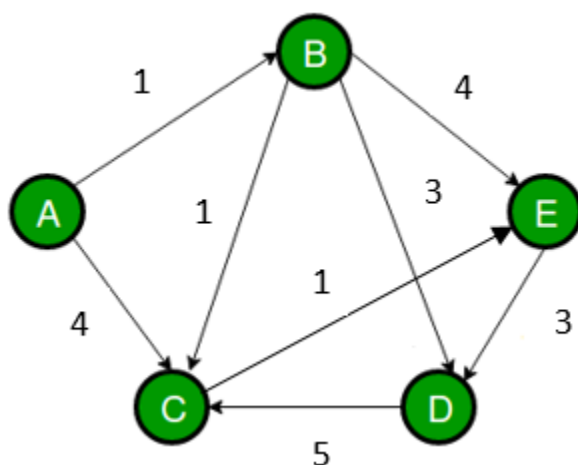
(6 marks)



- D. Draw a red-black tree using the given data (need to specify each step). (4 Marks)
Data : 6 ,3, 9 ,7 ,10 ,23
- E. Draw a minimum heap to record using the following data items. (5 Marks)
Data : 50, 20, 35, 60, 19 ,14
- F. Write a bubble sort algorithm to sort a given set of values. (8 Marks)
Comment each line to state the meaning.

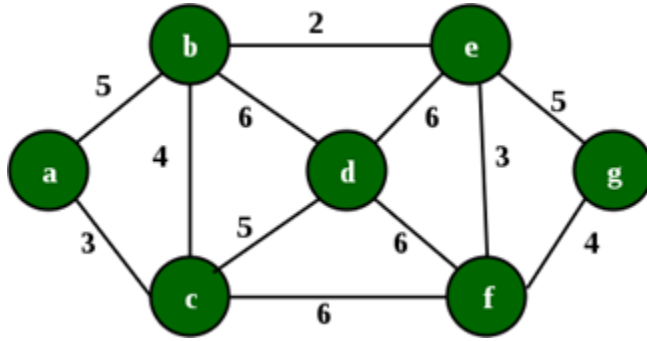
Question 5 (20 Marks)

- A. Consider the following graph.



If A is the source vertex, use the shortest path to reach every other vertex in the graph. (8 marks)

B. Find the minimum cost spanning tree for the graph given below. (6 marks)



C. What will be the time complexity of the following functions and codes? (6 marks)

a. $f(n) = 4n + 3n^2 + n \log n$

b.

```
int tot=0;
for ( int r=0; r<6;r++)
{
    tot+=r;
}
```