



Instructions to candidates

Number of questions: Six (06)

Time allocation: Three (03) hours

Mark allocation: 100

Answer all questions.

1.

- a. What is an algorithm? Mention the purpose of analyzing the complexity of an algorithm considering the efficiency measurements. (4 mark)
- b. Using the RAM model, analyze the total running time of the following algorithm. Show the steps in each statement.

```
SmartFibonacci(n)
if n = 0
    then return 0
elseif n = 1
    then return 1
else pprev ← 0
     prev ← 1
     for i ← 2 to n
         do f ← prev + pprev
            pprev ← prev
            prev ← f
return f
```

- c. Find the complexity of the following equations using big O notation.

- i. $T(n) = 6 \log_8 n + \log_2 \log_2 \log_2 n$
- ii. $T(n) = 0.3n + 5n^{1.5} + 2.5 \cdot n^{1.75}$
- iii. $T(n) = 100n \log_3 n + n^3 + 100n$

- d. Assuming that you are a shop keeper, write an algorithm for the following scenario.

You need to calculate the discount that your customers receive based on the value of their order. If the total amount is less than Rs.2,000, then the discount will not be given. If the total amount is between Rs.2,000 and Rs.5,000, 5% discount will be given. If the total amount is greater than Rs.5,000 and less than Rs.10,000, 10% discount will be given. If the total amount is Rs.10,000 or more, a premium customer receives 20% discount and a regular customer receives 15% discount.

(6 mark)

2.

- a. Write the pseudocode for 'Bubble Sort' algorithm. (6 mark)
- b. A student is using the bubble sort to rearrange seven (07) numbers in ascending order. Her correct solution is as follows.

Initial List	18	17	13	26	10	14	24
After 1 st pass	17	13	18	10	14	24	26
After 2 nd pass	13	17	10	14	18	24	26
After 3 rd pass	13	10	14	17	18	24	26
After 4 th pass	10	13	14	17	18	24	26
After 5 th pass	10	13	14	17	18	24	26

- i. Write the number of comparisons and swaps on each of the five passes while illustrating the answer (10 mark)
- ii. Find the maximum number of comparisons and the maximum number of swaps that might be needed in the bubble sort to rearrange seven (07) numbers in ascending order (4 mark)

3.

- a. What is 'Binary Search Tree (BST)'? (2 mark)
- b. Draw the binary search tree by inserting the following numbers in the given order. 50,30,25,75,82,28,63,70,4,43,74,35 (4 mark)
- c. Perform the following operations by using the following binary search tree.(Indicate the steps clearly)
- Pre Order Traversal
 - Post Order Traversal
 - In order Traversal
- (9 mark)

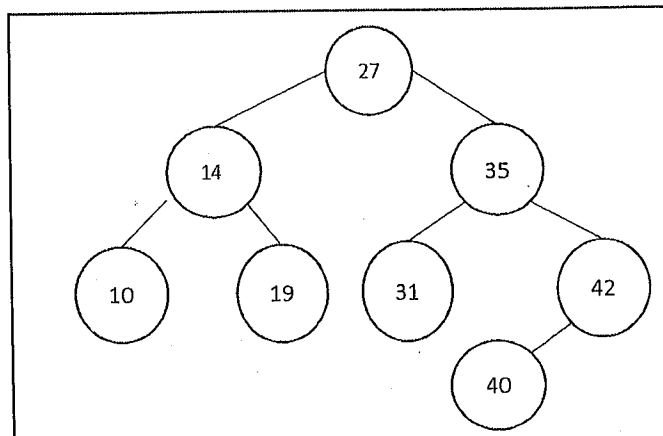


Figure 1 : Binary Search Tree

4.

- a. What is a Data Structure in computer programming? (1 mark)
- b. Compare and contrast linear queue vs circular queue (3 mark)
- c. Write an algorithm for a recursive function to print the data in the links of a singly-linked list. (5 mark)
- d. What are the data structures that can be used to implement the following application? Justify your answers.

"Easy Savings" is a newly introduced savings account in ABC Bank. Recently bank decided to conduct a promotion campaign to encourage their customers to use the newly introduced savings account. Usually they maintain a first come first serve basis list to record the necessities of each user. Meanwhile they use another list to save the user details for the promotion. Those details will be used by a software agent to determine the winner of the promotion program. This software records the user details according to the last come first serve basis. Software agent will track the previous transaction details of each customer in the list.

(6 mark)

5.

- a. What is 'Graph' in data structure? (1 mark)
- b. Write a pseudo-code for the breadth-first traversal of an undirected graph. (4 mark)
- c. Find the Minimum Spanning Tree(MST) for the Figure 2 using the following algorithms(State the steps clearly)

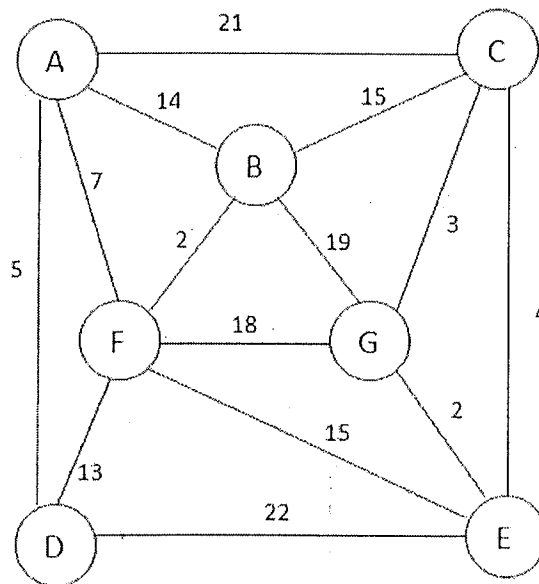


Figure 2 : Graph

- i. Kruskal's Algorithm
- ii. Prim's Algorithm (Start at node A)

(10 mark)

6.

- a. What is 'Hashing' in data structure? (1 mark)
- b. Define the 'Collision' in hashing. (2 mark)
- c. You are given a set of values as (19,26,13,48,17), a hash table of size 7 and hash function $h(k) = k \text{ mode } 7$. Draw the resulting tables after inserting the values in the given order for the following collision resolution strategies. (Mention the steps clearly)
- i. Separate Chaining
 - ii. Linear Probing
 - iii. Double Hashing with the secondary hash function $h'(k) = 5 - (k \text{ mod } 5)$

(12 mark)

