- EXAM PAPER
- Core Concepts (Chapters 1-16)
- Instructions
 - Time Allowed: 4 hours (0900-1300)
 - Total Marks: 100
 - Allowed Resources: None
 - Answer all questions.
- Section 1: Core Concepts (40 Marks)
- Question 1: Big O Notation (10 Marks)
- a) Explain the concept of Big O notation and provide examples of O(1), O(n), and $O(n^2)$. (5 Marks)
- b) Analyze the time complexity of the following code snippet:

java

(5 Marks)

```
Copy
for (int i = 0; i < n; i++) {
   for (int j = i; j < n; j++) {
      System.out.println(i + " " + j);
   }
}</pre>
```

- → Question 2: Arrays vs Linked Lists (10 Marks)
- a) Compare and contrast arrays and linked lists in terms of memory allocation, access time, and insertion/deletion operations. (5 Marks)
- b) Write a Java method to detect a cycle in a singly linked list. (5 Marks)

- → Question 3: Stacks and Queues (10 Marks)
- a) Explain the difference between a stack and a queue. Provide real-world examples where each data structure would be useful. (5 Marks)
- b) Implement a queue using two stacks in Java. (5 Marks)
- Question 4: Recursion (10 Marks)
- a) Write a recursive Java method to calculate the Fibonacci sequence. (5 Marks)
- b) Explain the concept of recursion depth and how it can lead to a stack overflow. (5 Marks)
- Section 2: Searching & Dictionaries (20 Marks)
- → Question 5: Linear vs Binary Search (10 Marks)
- a) Compare linear search and binary search in terms of time complexity and use cases. (5 Marks)
- b) Implement a binary search algorithm in Java. (5 Marks)
- Question 6: HashMaps (10 Marks)
- a) Explain how a HashMap works in Java, including how collisions are handled. (5 Marks)
- b) Write a Java program to find the first non-repeating character in a string using a HashMap. (5 Marks)
- Section 3: Hashing (10 Marks)
- Question 7: Hash Functions (10 Marks)
- a) Explain the concept of a hash function and its role in hash tables. (5 Marks)
- b) Compare open addressing and chaining as collision resolution techniques. (5 Marks)
- Section 4: Trees & Binary Search Trees (20 Marks)
- ★ Question 8: Binary Trees (10 Marks)

- a) Explain the difference between a binary tree and a binary search tree. (5 Marks)
- b) Write a Java method to perform a preorder traversal of a binary tree. (5 Marks)
- → Question 9: Binary Search Trees (10 Marks)
- a) Implement a Java method to delete a node from a binary search tree. (5 Marks)
- b) Write a Java method to check if a binary tree is a valid binary search tree. (5 Marks)
- Section 5: Graphs (10 Marks)
- → Question 10: Graph Traversal (10 Marks)
- a) Explain the difference between BFS and DFS in graph traversal. (5 Marks)
- b) Implement BFS in Java to traverse a graph represented as an adjacency list. (5 Marks)
- 🞉 Good Luck! 🎉
- How to Submit:
 - 1. Write your answers in a separate document or PDF.
 - 2. Ensure your name and student ID are clearly marked on the first page.
 - 3. Submit your answers via the designated platform before the deadline.
- m Deadline:

14th May 2024, 1300 Hours

This exam paper is designed to test your understanding of the core concepts, data structures, and algorithms covered in your syllabus. Good luck! •

You can copy this text into a PDF creator like Microsoft Word, Google Docs, or any other tool to generate a PDF. Let me know if you need further assistance!

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