📝 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 with examples. (5 Marks)
b) Analyze the time complexity of the following code snippet:

java

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

(5 Marks)

📌 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 reverse 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 stack using Java and write a method to check if a given string of parentheses is balanced. (5 Marks)

📌 Question 4: Recursion (10 Marks)

a) Write a recursive Java method to calculate the factorial of a number. (5 Marks)
b) Explain the concept of tail recursion and how it can optimize recursive functions. (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 count the frequency of each word in a given text 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 an inorder traversal of a binary tree. (5 Marks)

📌 Question 9: Binary Search Trees (10 Marks)

a) Implement a Java method to insert a node into a binary search tree. (5 Marks)
b) Write a Java method to find the height of a 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 Dijkstra's algorithm in Java to find the shortest path between two nodes in a graph. (5 Marks)

Good Luck!