

**CS-M51**  
**DATA STORAGE AND MANIPULATION**  
*(Attempt 2 questions out of 3)*

**Question 1**

- a.** Define the concept of a **stack** by defining the operations that may be performed on it. Include in your answer a list of the operations required along with the arguments required for each operation and the results of each of each operation. Define the relationships between the operations and indicate whether or not this is a minimal set of operations.  
**[8 marks]**
- b.** Outline how Java style classes may be used to implement a stack (as defined in **(a)**) using
- i)** a Java array (not a vector or ArrayList)
  - ii)** references
- Discuss the relative merits of each approach. Full code is not required.  
**[8 marks]**
- c.** Stacks may be considered to be a special type of **list**. Other types of list include **queues** and **double-ended queues**. Explain what is meant by this and briefly indicate how the implementation approaches taken in **(b)** could be adapted to implement all the different types of list.  
**[4 marks]**
- d.** Outline how a stack might be used in
- i)** the management of static memory
  - ii)** depth-first traversal of a graph
- [5 marks]**

## Question 2

a. Give brief definitions of the following terms

- i) Complete Binary Tree
- ii) AVL Tree
- iii) 2-3 Tree
- iv) B Tree
- v) Hash Table
- vi) Index Table

[6 marks]

b. In the context of a Hash Table explain what is meant by

- i) Collision
- ii) Primary Clustering
- iii) Chaining

[3 marks]

c. **Hash Tables, Index Tables,** and various types of **Tree** may all be used to store large amounts of data, and avoid the need for a linear search through all the data when an item needs to be retrieved. Discuss the factors you would consider when deciding which approach to use.

[8 marks]

d. Three common approaches to allocating disk space are **contiguous, chained,** and **indexed.** Explain how each of these approaches work and discuss their advantages and disadvantages

[8 marks]

### Question 3

a. Briefly explain what is meant by the following terms

- i) Distributed System
- ii) Multiprocessor System

What are the differences and similarities?

**[6 marks]**

b. Describe the basic architecture for a Distributed File System and outline the options for the semantics of file sharing.

**[8marks]**

c. Explain the difference between Static and Dynamic data storage and outline how dynamic data storage can be managed. Your answer should include a brief description of how free-lists can be used and the implications of allocating memory blocks of different sizes. The following terms should be explained:

- i) first-fit
- ii) best-fit
- iii) next-fit
- iv) fragmentation
- v) reference counting
- vi) mark and release garbage collection
- vii) buddy system

**[11 marks]**