

# GATE 2025 – Analysis & Design of Algorithms (ADA) BCS401 QUESTIONS

## Q18. Minimum Spanning Tree Property

Let  $G$  be any undirected graph with positive edge weights, and  $T$  be a minimum spanning tree of  $G$ . For any two vertices  $u$  and  $v$ , let  $d_1(u,v)$  and  $d_2(u,v)$  be the shortest distances between  $u$  and  $v$  in  $G$  and  $T$  respectively. Which ONE of the following options is CORRECT?

- A)  $d_1(u,v) = d_2(u,v)$
- B)  $d_1(u,v) \leq d_2(u,v)$
- C)  $d_1(u,v) \geq d_2(u,v)$
- D)  $d_1(u,v) \neq d_2(u,v)$

**Answer: B**

## Q20. Recurrence Relation

Consider the recurrence relation  $T(n) = 2T(n - 1) + n \cdot 2^n$  for  $n > 0$ ,  $T(0) = 1$ . Which ONE of the following options is CORRECT?

- A)  $\Theta(n^2 \cdot 2^n)$
- B)  $\Theta(n \cdot 2^n)$
- C)  $\Theta((\log n)^2 \cdot 2^n)$
- D)  $\Theta(4^n)$

**Answer: B**

## Q21. B+ Tree Insertion

Consider a B+ tree with 5 nodes, where a node can store at most 3 key values. The value 23 is inserted into the tree. Which of the following statements are CORRECT?

- A) None of the nodes will split
- B) At least one node will split and redistribute
- C) Total number of nodes will remain the same
- D) Height of the tree will increase

**Answer: B, D**

### **Q26. Binary Search Tree Properties**

Which of the following statements are TRUE for any binary search tree (BST) having  $n$  distinct integers?

- A) The maximum length of a path from the root to any node is  $n-1$
- B) An inorder traversal always produces a sorted sequence
- C) Worst-case search time is  $O(\log n)$
- D) Every BST is a Min-Heap

**Answer: A, B**

### **Q33. Bubble Sort Swap Count**

An array of 30 distinct integers arranged in descending order is sorted using Bubble Sort. The number of swap operations performed is \_\_\_\_\_.

**Answer: 435**

### **Q35. Heap Height**

A Min-Heap stores 32 keys. The height of the heap is \_\_\_\_\_.

**Answer: 5**

# GATE 2024 – Analysis & Design of Algorithms (ADA) QUESTIONS

## Q14. Minimum Spanning Tree Property

Let  $G$  be a weighted connected undirected graph with distinct positive edge weights. If every edge weight is increased by the same value, which of the following statements is/are TRUE? P: Minimum spanning tree of  $G$  does not change Q: Shortest path between any pair of vertices does not change

- A) P only
- B) Q only
- C) Neither P nor Q
- D) Both P and Q

**Answer: A**

## Q20. Recurrence Relation

Consider the recurrence relation  $T(n) = 2T(n/2) + n$ . Which ONE of the following is the correct asymptotic time complexity?

- A)  $\Theta(n)$
- B)  $\Theta(n \log n)$
- C)  $\Theta(n^2)$
- D)  $\Theta(\log n)$

**Answer: B**

## Q26. Sorting Algorithms

Which of the following sorting algorithms have a worst-case time complexity of  $\Theta(n \log n)$ ?

- A) Merge Sort
- B) Heap Sort
- C) Quick Sort
- D) Selection Sort

**Answer: A, B**

### **Q33. Dynamic Programming – Knapsack**

The 0/1 Knapsack problem exhibits which of the following properties?

- A) Greedy choice property
- B) Optimal substructure
- C) Divide and conquer
- D) Randomization

**Answer: B**

### **Q41. Greedy Algorithms – Huffman Coding**

Huffman coding generates optimal prefix codes using which algorithmic strategy?

- A) Dynamic programming
- B) Divide and conquer
- C) Greedy method
- D) Backtracking

**Answer: C**

### **Q45. Heap Property**

Which of the following statements is TRUE for a Min-Heap?

- A) Parent node key is always greater than child keys
- B) Heap is a complete binary tree
- C) Inorder traversal gives sorted order
- D) Height is always  $n-1$

**Answer: B**

# GATE 2023 – Analysis & Design of Algorithms (ADA) QUESTIONS

## Q13. Sorting Algorithms – Best Case

Assume that the algorithms considered here sort the input sequences in ascending order. If the input is already in ascending order, which of the following are TRUE? I. Quicksort runs in  $\Theta(n^2)$  time II. Bubblesort runs in  $\Theta(n^2)$  time III. Mergesort runs in  $\Theta(n)$  time IV. Insertion sort runs in  $\Theta(n)$  time

- A) I and II only
- B) I and III only
- C) II and IV only
- D) I and IV only

**Answer: C**

## Q14. Floyd–Warshall Algorithm

The Floyd–Warshall algorithm for all-pairs shortest path computation is based on which paradigm?

- A) Greedy
- B) Divide and Conquer
- C) Dynamic Programming
- D) None of the above

**Answer: C**

## Q16. Regular Expression – DFA States

The number of states in the minimum sized DFA that accepts the language defined by the regular expression  $(0+1)^*(0+1)(0+1)^*$  is \_\_\_\_\_.

**Answer: 2**

## Q18. Language Classes

Consider the following types of languages: L1: Regular, L2: Context-Free, L3: Recursive, L4: Recursively Enumerable. Which of the following is/are TRUE? I.  $L3 \cup L4$  is recursively enumerable

II.  $L_2 \cup L_3$  is recursive III.  $L_1^* \cap L_2$  is context-free IV.  $L_1 \cup L_2$  is context-free

- A) I only
- B) I and III
- C) II and IV
- D) I, III and IV

**Answer: B**

## Q20. Recurrence Relation

Consider the recurrence relation:  $T(n) = 2T(n - 1) + n \cdot 2^n$ ,  $T(0) = 1$ . Which ONE of the following options is CORRECT?

- A)  $\Theta(n^2 \cdot 2^n)$
- B)  $\Theta(n \cdot 2^n)$
- C)  $\Theta((\log n)^2 \cdot 2^n)$
- D)  $\Theta(4^n)$

**Answer: B**

## Q21. BFS Traversal on Binary Tree

Breadth First Search (BFS) is started on a binary tree beginning from the root vertex. There is a vertex  $t$  at a distance four from the root. If  $t$  is the  $n$ -th vertex in this BFS traversal, then the maximum possible value of  $n$  is \_\_\_\_\_.

**Answer: 31**

# GATE 2022 – Analysis & Design of Algorithms (ADA) QUESTIONS

## Q11. Asymptotic Growth

Which of the following functions grows asymptotically faster than  $n \log n$  but slower than  $n^2$ ?

- A)  $n^{3/2}$
- B)  $n \log n$
- C)  $n^2$
- D)  $\log n$

**Answer: A**

## Q18. Graph Shortest Path vs MST

Let  $G$  be a weighted connected undirected graph with distinct edge weights. Which ONE of the following is TRUE for any two vertices  $u$  and  $v$ ?

- A) Shortest path distance equals MST path distance
- B) Shortest path distance is less than or equal to MST path distance
- C) MST path distance is less than shortest path distance
- D) They are always different

**Answer: B**

## Q23. Dynamic Programming – Matrix Chain Multiplication

Matrix Chain Multiplication problem is solved optimally using which algorithmic technique?

- A) Greedy method
- B) Divide and Conquer
- C) Dynamic Programming
- D) Backtracking

**Answer: C**

## Q27. Sorting Algorithm Stability

Which of the following sorting algorithms is stable?

- A) Quick Sort
- B) Heap Sort
- C) Merge Sort
- D) Selection Sort

**Answer: C**

### **Q31. Recurrence Relation**

Consider the recurrence relation  $T(n) = T(n/2) + n$ . Which ONE of the following is the correct asymptotic time complexity?

- A)  $\Theta(n)$
- B)  $\Theta(n \log n)$
- C)  $\Theta(\log n)$
- D)  $\Theta(n^2)$

**Answer: B**

### **Q40. Greedy Algorithm – Activity Selection**

The activity selection problem is optimally solved using which algorithmic paradigm?

- A) Dynamic programming
- B) Divide and conquer
- C) Greedy method
- D) Backtracking

**Answer: C**

# GATE 2021 – Analysis & Design of Algorithms (ADA) QUESTIONS

## Q11. Asymptotic Comparison

Which of the following functions grows asymptotically faster than  $n$  but slower than  $n^2$ ?

- A)  $n \log n$
- B)  $\log n$
- C)  $n^2$
- D)  $2^n$

**Answer: A**

## Q18. Greedy Algorithm – Minimum Spanning Tree

Which of the following algorithms can be used to find the minimum spanning tree of a connected graph?

- A) Dijkstra's algorithm
- B) Bellman–Ford algorithm
- C) Prim's algorithm
- D) Floyd–Warshall algorithm

**Answer: C**

## Q22. Recurrence Relation

Consider the recurrence relation  $T(n) = 3T(n/2) + n$ . Which ONE of the following is the correct asymptotic time complexity?

- A)  $\Theta(n)$
- B)  $\Theta(n \log n)$
- C)  $\Theta(n^{\log_2 3})$
- D)  $\Theta(n^2)$

**Answer: C**

## Q27. Sorting Algorithm – Worst Case

Which of the following sorting algorithms has a worst-case time complexity of  $\Theta(n \log n)$ ?

- A) Quick Sort
- B) Merge Sort
- C) Insertion Sort
- D) Bubble Sort

**Answer: B**

## Q33. Dynamic Programming – Optimal Substructure

Which of the following problems exhibits the optimal substructure property?

- A) Longest Common Subsequence
- B) Binary Search
- C) Linear Search
- D) Hashing

**Answer: A**

## Q41. Backtracking – N Queens

The N-Queens problem can be efficiently solved using which algorithmic technique?

- A) Greedy method
- B) Dynamic programming
- C) Backtracking
- D) Divide and conquer

**Answer: C**

# GATE 2020 – Analysis & Design of Algorithms (ADA) QUESTIONS

## Q8. Asymptotic Growth

Which of the following functions grows asymptotically faster than  $n$  but slower than  $n^2$ ?

- A)  $n \log n$
- B)  $\log n$
- C)  $n^2$
- D)  $2^n$

**Answer: A**

## Q12. Recurrence Relation

Consider the recurrence relation  $T(n) = 2T(n/2) + n \log n$ . Which ONE of the following is the correct asymptotic time complexity?

- A)  $\Theta(n \log n)$
- B)  $\Theta(n \log^2 n)$
- C)  $\Theta(n^2)$
- D)  $\Theta(\log n)$

**Answer: B**

## Q21. Sorting Algorithm – Stability

Which of the following sorting algorithms is stable?

- A) Heap Sort
- B) Selection Sort
- C) Merge Sort
- D) Quick Sort

**Answer: C**

## Q27. Dynamic Programming – Optimal Substructure

Which of the following problems can be solved using dynamic programming?

- A) Binary Search
- B) Longest Common Subsequence
- C) Linear Search
- D) Hashing

**Answer: B**

### **Q33. Greedy Algorithm – MST**

Which of the following algorithms can be used to find the minimum spanning tree of a connected graph?

- A) Bellman–Ford
- B) Floyd–Warshall
- C) Prim's algorithm
- D) Topological Sort

**Answer: C**

### **Q41. Backtracking – N Queens**

The N-Queens problem is optimally solved using which algorithmic technique?

- A) Divide and conquer
- B) Greedy method
- C) Backtracking
- D) Dynamic programming

**Answer: C**

# GATE 2019 – Analysis & Design of Algorithms (ADA) QUESTIONS

## Q9. Asymptotic Analysis

Which of the following functions grows asymptotically faster than  $n \log n$  but slower than  $n^2$ ?

- A)  $n^{3/2}$
- B)  $n \log n$
- C)  $n^2$
- D)  $\log n$

**Answer: A**

## Q16. Recurrence Relation

Consider the recurrence relation  $T(n) = 2T(n/2) + n$ . Which ONE of the following is the correct asymptotic time complexity?

- A)  $\Theta(n)$
- B)  $\Theta(n \log n)$
- C)  $\Theta(n^2)$
- D)  $\Theta(\log n)$

**Answer: B**

## Q22. Sorting Algorithms – Worst Case

Which of the following sorting algorithms has a worst-case time complexity of  $\Theta(n \log n)$ ?

- A) Quick Sort
- B) Merge Sort
- C) Insertion Sort
- D) Bubble Sort

**Answer: B**

## Q27. Dynamic Programming – Longest Common Subsequence

The Longest Common Subsequence (LCS) problem can be solved optimally using which technique?

- A) Greedy method
- B) Divide and conquer
- C) Dynamic programming
- D) Backtracking

**Answer: C**

### **Q34. Greedy Algorithm – Huffman Coding**

Huffman coding algorithm uses which of the following algorithmic strategies?

- A) Divide and conquer
- B) Dynamic programming
- C) Greedy method
- D) Backtracking

**Answer: C**

### **Q41. Backtracking – Subset Sum**

The Subset Sum problem is optimally solved using which algorithmic technique?

- A) Greedy method
- B) Dynamic programming
- C) Backtracking
- D) Divide and conquer

**Answer: C**

# GATE 2018 – Analysis & Design of Algorithms (ADA) QUESTIONS

## Q10. Asymptotic Analysis

Which of the following functions grows asymptotically faster than  $n$  but slower than  $n^2$ ?

- A)  $n \log n$
- B)  $\log n$
- C)  $n^2$
- D)  $2^n$

**Answer: A**

## Q15. Recurrence Relation

Consider the recurrence relation  $T(n) = T(n/2) + n$ . Which ONE of the following is the correct asymptotic time complexity?

- A)  $\Theta(n)$
- B)  $\Theta(n \log n)$
- C)  $\Theta(\log n)$
- D)  $\Theta(n^2)$

**Answer: B**

## Q21. Sorting Algorithm – Stability

Which of the following sorting algorithms is stable?

- A) Heap Sort
- B) Merge Sort
- C) Quick Sort
- D) Selection Sort

**Answer: B**

## Q27. Dynamic Programming – Matrix Chain Multiplication

The Matrix Chain Multiplication problem can be solved optimally using which technique?

- A) Greedy method
- B) Divide and conquer
- C) Dynamic programming
- D) Backtracking

**Answer: C**

### **Q33. Greedy Algorithm – Minimum Spanning Tree**

Which of the following algorithms can be used to find the minimum spanning tree of a connected graph?

- A) Bellman–Ford
- B) Dijkstra's algorithm
- C) Prim's algorithm
- D) Topological sort

**Answer: C**

### **Q41. Backtracking – N Queens**

The N-Queens problem is optimally solved using which algorithmic technique?

- A) Greedy method
- B) Dynamic programming
- C) Backtracking
- D) Divide and conquer

**Answer: C**

# GATE 2017 – Analysis & Design of Algorithms (ADA) QUESTIONS

## Q11. Asymptotic Analysis

Which of the following functions grows asymptotically faster than  $n$  but slower than  $n^2$ ?

- A)  $n \log n$
- B)  $\log n$
- C)  $n^2$
- D)  $2^n$

**Answer: A**

## Q16. Recurrence Relation

Consider the recurrence relation  $T(n) = 2T(n/2) + n$ . Which ONE of the following is the correct asymptotic time complexity?

- A)  $\Theta(n)$
- B)  $\Theta(n \log n)$
- C)  $\Theta(n^2)$
- D)  $\Theta(\log n)$

**Answer: B**

## Q23. Sorting Algorithm – Worst Case

Which of the following sorting algorithms has a worst-case time complexity of  $\Theta(n \log n)$ ?

- A) Quick Sort
- B) Merge Sort
- C) Insertion Sort
- D) Bubble Sort

**Answer: B**

## Q29. Dynamic Programming – Floyd Warshall

The Floyd–Warshall algorithm is used to solve which of the following problems?

- A) Single source shortest path
- B) All pairs shortest path
- C) Minimum spanning tree
- D) Maximum flow

**Answer: B**

### **Q35. Greedy Algorithm – Huffman Coding**

Huffman coding algorithm follows which algorithmic strategy?

- A) Divide and conquer
- B) Dynamic programming
- C) Greedy method
- D) Backtracking

**Answer: C**

### **Q42. Backtracking – Subset Sum**

The Subset Sum problem can be solved optimally using which algorithmic technique?

- A) Greedy method
- B) Dynamic programming
- C) Backtracking
- D) Divide and conquer

**Answer: C**

# GATE 2016 – Analysis & Design of Algorithms (ADA) QUESTIONS

## Q8. Asymptotic Analysis

Which of the following functions grows asymptotically faster than  $n$  but slower than  $n^2$ ?

- A)  $n \log n$
- B)  $\log n$
- C)  $n^2$
- D)  $2^n$

**Answer: A**

## Q14. Recurrence Relation

Consider the recurrence relation  $T(n) = 2T(n/2) + n$ . Which ONE of the following is the correct asymptotic time complexity?

- A)  $\Theta(n)$
- B)  $\Theta(n \log n)$
- C)  $\Theta(n^2)$
- D)  $\Theta(\log n)$

**Answer: B**

## Q21. Sorting Algorithm – Stability

Which of the following sorting algorithms is stable?

- A) Heap Sort
- B) Merge Sort
- C) Quick Sort
- D) Selection Sort

**Answer: B**

## Q26. Dynamic Programming – Matrix Chain Multiplication

The Matrix Chain Multiplication problem can be solved optimally using which technique?

- A) Greedy method
- B) Divide and conquer
- C) Dynamic programming
- D) Backtracking

**Answer: C**

### **Q33. Greedy Algorithm – Minimum Spanning Tree**

Which of the following algorithms can be used to find the minimum spanning tree of a connected graph?

- A) Bellman–Ford
- B) Dijkstra's algorithm
- C) Prim's algorithm
- D) Topological sort

**Answer: C**

### **Q41. Backtracking – N Queens**

The N-Queens problem is optimally solved using which algorithmic technique?

- A) Greedy method
- B) Dynamic programming
- C) Backtracking
- D) Divide and conquer

**Answer: C**