

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: V - THEORY EXAMINATION (2025 - 2026)

Subject: Design and Analysis of Algorithms

Time: 3 Hours

Max. Marks: 100

General Instructions:

IMP: Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of **three Sections -A, B, & C**. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.

2. Maximum marks for each question are indicated on right -hand side of each question.

3. Illustrate your answers with neat sketches wherever necessary.

4. Assume suitable data if necessary.

5. Preferably, write the answers in sequential order.

6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION-A

20

1. Attempt all parts:-

1-a. Complexity of counting sort is : (CO1), K2

1

- (a) $O(n)$
- (b) $O(\log n)$
- (c) $O(n+k)$
- (d) $O(n^2)$

1-b. Which case indicate the minimum time required for program execution? (CO1), K2

1

- (a) best case
- (b) average case
- (c) worst case
- (d) None of the above

1-c. In a Red-Black tree the number of black nodes in all branches will be: (CO2), K4

1

- (a) Same
- (b) Different
- (c) Double
- (d) Half

1-d. If a Binomial tree follows max heap, then the root node will contain: (CO2), K4

1

- (a) Smallest value
- (b) Largest Value
- (c) Null Value
- (d) None of the above

1-e. This algorithm is also called "General purpose sorting algorithm". (CO3), K2

1

- (a) Heap sort
 (b) Quick sort
 (c) merge sort
 (d) Counting sort
- 1-f. What is the worst case complexity of convex hull? (CO3), K4 1
 (a) $O(N)$
 (b) $O(N \log N)$
 (c) $O(N^2)$
 (d) $O(\log N)$
- 1-g. In a non-weighted graph: (CO4), K2 1
 (a) The height of a tree is given
 (b) The depth of a tree is given
 (c) Number of connected components are given
 (d) Value of edge is given
- 1-h. _____ is an example of backtracking algorithm. (CO4), K4 1
 (a) Quick Sort
 (b) Linear Search
 (c) N-Queen Problem
 (d) All of the above
- 1-i. Which of the following is true about NP-Complete and NP-Hard problems. (CO5), K4 1
 (a) If we want to prove that a problem X is NP-Hard, we take a known NP-Hard problem Y and reduce Y to X
 (b) The first problem that was proved as NP-complete was the circuit satisfiability problem.
 (c) NP-complete is a subset of NP Hard
 (d) All of the above
- 1-j. Let X is a problem that belongs to the class NP. Then which one of the following is. (CO5), K2 1
 (a) There is no polynomial time algorithm for X.
 (b) If X can be solved deterministically in polynomial time, then $P = NP$.
 (c) If X is NP-hard, then it is NP-complete
 (d) X may be undecidable.

2. Attempt all parts:-

- 2.a. Name the algorithm which works on gap analysis. Briefly discuss the algorithm. (CO1), K2 2
- 2.b. Insert the following keys into B-tree: - 40,35,22,90 and $t=3$. (CO2), K3 2
- 2.c. Write short note on Kruskal's algorithm (CO3), K2 2
- 2.d. Compare BFS and DFS. (CO4), K4 2
- 2.e. Briefly discuss Randomized algorithm. (CO5), K2 2

SECTION-B

30

3. Attempt all parts:-
- 3.a. Answer any one of the following:-
- 3.a.(i) Derive a recurrence relation for Merge sort algorithm. Also find its complexity. (CO1), K3 6
- 3.a.(ii) Solve the Following recurrence relation using recursion tree method. (CO1),K3 6
 $T(n) = 2T(n/2)+3n^2$
 $T(1) = 11.$
- 3.b. Answer any one of the following:-
- 3.b.(i) Insert the following nodes in Binomial heap. { 10, 30, 20, 50, 40, 90, 80, 15, 60} (CO2),K3 6
- 3.b.(ii) According to you among AVL tree and Red-Black tree which one is better and why? (CO2), K4 6
- 3.c. Answer any one of the following:-
- 3.c.(i) Implement Prim's algorithm. Take an example and find MST of any graph using Prim's algorithm. (CO3), K3 6
- 3.c.(ii) State the use of Huffman code algorithm. Find the Huffman code for the character of given text file. (CO3), K4 6
Character: <a,b,c,d,e,f>
Frequency:<45, 5, 20, 15, 10, 25>
- 3.d. Answer any one of the following:-
- 3.d.(i) Discuss Floyd Warshall algorithm with an example.. Write the complexity of the algorithm. (CO4), K3 6
- 3.d.(ii) What is a Hamiltonian Cycle ? Explain how to find Hamiltonian path and cycle using backtracking algorithm. (CO4), K2 6
- 3.e. Answer any one of the following:-
- 3.e.(i) Illustrate how to implement an algorithm for Knapsack problem using NP-Hard approach.(CO5), K3 6
- 3.e.(ii) Give some examples of P and NP problem. (CO5), K3 6
- SECTION-C** 50
4. Answer any one of the following:-
- 4-a. Solve the following recurrence relation using Master's theorem- (CO1), K4 10
 $T(n) = 9T(n/3) + n$
 $T(n) = 2T(n/2) + n \log n$
- 4-b. Sort the given elements using Heap sort: 66, 23, 12, 56, 19, 43. Write the algorithm for same. (CO1), K3 10
5. Answer any one of the following:-
- 5-a. Explain B Tree. Compare B-Tree and BST. (CO2), K4 10
- 5-b. Define the Fibonacci Heap. Explain the structure of Fibonacci Heap. And also its operation. (CO2), K2 10
6. Answer any one of the following:-
- 6-a. What do you understand by a minimum spanning tree? What is a spanning tree? What are its use and application? (CO3), K4 10

- 6-b. Discuss Dijkstra's algorithm with a proper example. (CO3), K3 10
7. Answer any one of the following:-
- 7-a. Discuss dynamic programming. Fill the given items in the bag of capacity 9 Kg using 0/1 knapsack algorithm. Items(A, B, C, D), weight(2, 5, 4, 3), Profit(7, 5, 8, 3). (CO4), K3 10
- 7-b. Differentiate between planar and non planar graph. Graph coloring problem can apply on them, Explain for Bipartite graph how many colors required to color the graph. Apply backtracking on the following instance of graph coloring problem of 4 nodes and 3 colors. (CO4), K4 10
8. Answer any one of the following:-
- 8-a. (a) How do we prove that a given problem is in NP? (CO5), K2 10
(b) How do we prove that a given problem is in NPC?
- 8-b. With an example explain KMP algorithm. (CO5), K2 10

REG_JULY_DEC_2025