B.Tech. DEGREE EXAMINATION, JUNE 2023

Fifth Semester

18CSC361J - DESIGN AND ANALYSIS OF ALGORITHMS

(For the candidates admitted during the academic year 2018-2019 to 2021-2022)

Note:

i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40 minutes.

ii. **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours   Max. Marks: 100

Part - A (20 × 1 Marks = 20 Marks)
Answer All Questions

		Marks	BL	CO

1. What is the importance of "effectiveness" in an algorithm? — 1, 1, 1
   - (A) It ensures that the algorithm can be executed with available resources.
   - (B) It ensures that the algorithm produces the correct output.
   - (C) It ensures that the algorithm terminates after a finite number of steps.
   - (D) It ensures that the algorithm can solve a specific problem.

2. Which of the following is NOT necessary for an algorithm to be effective? — 1, 1, 1
   - (A) It should produce the correct output.
   - (B) It should use finite resources.
   - (C) It should be unique.
   - (D) It should terminate after a finite number of steps.

3. What is the time complexity of an algorithm that has a running time of $O(n^2)$? — 1, 1, 1
   - (A) Constant time complexity
   - (B) Linear time complexity
   - (C) Quadratic time complexity
   - (D) Exponential time complexity

4. Which of the following is true about the relationship between time complexity and input size of an algorithm? — 1, 1, 1
   - (A) Time complexity increases as input size increases
   - (B) Time complexity decreases as input size increases
   - (C) Time complexity remains constant regardless of input size.
   - (D) Time complexity is unrelated to input size

5. What is the brute force method in the context of problem-solving? — 1, 1, 2
   - (A) A method that relies on clever tricks and shortcuts to find a solution quickly
   - (B) A method that systematically tries every possible solution until a correct one is found.
   - (C) A method that involves guessing and checking until a solution is found.
   - (D) A method that uses statistical analysis to find the best solution.

6. What is a disadvantage of using the brute force method? — 1, 1, 2
   - (A) It always finds the optimal solution.
   - (B) It is faster than other problem-solving methods.
   - (C) It can be computationally expensive for large problem sizes.
   - (D) It is easier to implement than other problem-solving methods.

Part - C (5 × 12 Marks = 60 Marks)
Answer All Questions

		Marks	BL	CO

28. a. Solve the following recurrence relation using the substitution method and provide a detailed explanation of the various strategies to solve recurrence relations. — 12, 4, 1
    $T(n) = 2T(n/2) + n$.

    (OR)

    b. Implementing the method of solving recurrence equations with towers of Hanoi problem.

29. a. Explain the concept of single-source shortest path algorithms. Describe the Dijkstra's algorithm and the Bellman-Ford algorithm, and compare their similarities and differences. — 12, 4, 2

    (OR)

    b. Solve the 0-1 Knapsack problem using branch and bound and calculate the maximum profit obtained and items picked.

Items	Weight	Value
1	3	45
2	5	30
3	9	45
4	5	10

30. a. Explain the concept of a Binary Tree. Describe the different types of Binary Trees, including complete binary trees, full binary trees, and balanced binary trees. Finally, discuss the applications of Binary Trees in computer science. — 12, 4, 3

    (OR)

    b. Compute the minimum cost spanning tree for the graph below using Prim's algorithm.
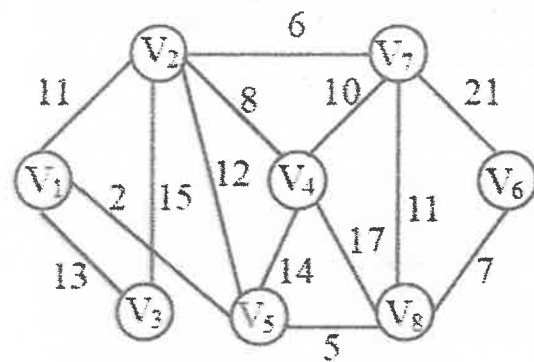
31. a. Explain the concept of computability classes, including the classes P, NP, NP-complete, and NP-hard. Describe the differences between these classes and discuss their importance in the field of computer science. — 12, 4, 4

    (OR)

    b. Distinguishing tractable and in-tractable problems with suitable examples.

32. a. Explain the Knapsack problem and how it can be solved using dynamic programming. Discuss the time complexity and limitations of the dynamic programming approach. — 12, 4, 5

    (OR)

    b. Explain quantum computing principles and discuss any three quantum algorithms.

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7. What is the main idea behind dynamic programming?   1   1   2
(A) To solve complex problems by breaking them down into smaller subproblems.
(B) To use randomness and probability to solve problems.
(C) To use heuristics to find approximate solutions to problems.
(D) To use brute force to systematically try all possible solutions.

8. What is memorization in the context of dynamic programming?   1   1   2
(A) A technique for solving problems by breaking them down into smaller subproblems.
(B) A technique for caching the results of expensive function calls and returning the cached result when the same inputs occur again.
(C) A technique for eliminating the need to solve a problem by exploiting its underlying structure.
(D) A technique for solving problems using heuristics and approximation.

9. What is a traversal algorithm in the context of data structures?   1   1   3
(A) An algorithm for sorting data in a specific order.
(B) An algorithm for searching for a specific element in a data structure.
(C) An algorithm for visiting every element in a data structure.
(D) An algorithm for modifying the elements in a data structure.

10. What is the difference between depth-first search and breadth-first search?   1   2   3
(A) Depth-first search visits nodes in order of their distance from the root node, while breadth-first search visits nodes in order of their level in the tree.
(B) Depth-first search uses a stack to keep track of visited nodes, while breadth-first search uses a queue.
(C) Depth-first search is faster than breadth-first search for large trees, while breadth-first search is faster for small trees.
(D) Depth-first search is more memory-efficient than breadth-first search.

11. What is the time complexity of the Floyd-Warshall algorithm?   1   1   3
(A) $O(n)$
(B) $O(n \log n)$
(C) $O(n^2)$
(D) $O(n^3)$

12. What is the main idea behind the Floyd-Warshall algorithm?   1   3   3
(A) To use dynamic programming to break down the problem of finding the transitive closure of a graph into smaller subproblems.
(B) To use depth-first search to explore all vertices in a graph and find the transitive closure.
(C) To use breadth-first search to explore all vertices in a graph and find the transitive closure.
(D) To use Dijkstra's algorithm to find the shortest path between all pairs of vertices in a graph.

13. What is a tractable algorithm?   1   1   4
(A) An algorithm that can solve problems in polynomial time.
(B) An algorithm that can solve problems in exponential time.
(C) An algorithm that can solve problems in logarithmic time.
(D) An algorithm that cannot solve problems.

14. What is an intractable algorithm?   1   1   3
(A) An algorithm that can solve problems in polynomial time.
(B) An algorithm that can solve problems in exponential time.
(C) An algorithm that can solve problems in logarithmic time.
(D) An algorithm that cannot solve problems.

15. Which of the following is not a characteristic of NP-type problems?   1   4   4
(A) They can be verified in polynomial time
(B) They have a non-deterministic algorithm
(C) They can be solved in exponential time
(D) They are guaranteed to have a unique solution

16. Which of the following statements is true about the relationship between NP-type problems and tractable algorithms?   1   4   4
(A) All NP-type problems have tractable algorithms
(B) No NP-type problems have tractable algorithms
(C) Some NP-type problems have tractable algorithms
(D) The concept of tractable algorithms is irrelevant to NP-type problems

17. What is the main goal of an approximation algorithm?   1   1   5
(A) To always find the exact optimal solution
(B) To find a near-optimal solution in a reasonable amount of time
(C) To find a solution with the highest probability of being optimal
(D) To find a solution using brute force

18. Which of the following is an example of an optimization problem that can be solved using an approximation algorithm?   1   3   5
(A) Sorting a list of numbers in ascending order
(B) Finding the shortest path between two nodes in a graph
(C) Calculating the value of a mathematical function
(D) Deciding whether a graph has a Hamiltonian cycle

19. What is the main advantage of randomized algorithms over deterministic algorithms?   1   5   5
(A) They always give the correct solution to a problem.
(B) They are faster than deterministic algorithms.
(C) They can find approximate solutions to problems efficiently.
(D) They are easier to implement than deterministic

20. Which of the following is a limitation of randomized algorithms?   1   4   5
(A) They are only useful for very simple problems.
(B) They always require a large amount of computational resources.
(C) They can sometimes give incorrect results.
(D) They are always slower than deterministic algorithms.

Part - B (5 × 4 Marks = 20 Marks)   Marks   BL   CO
Answer **any 5** Questions

21. Explain the significance of asymptotic analysis in algorithm design and how it helps in selecting the best algorithm for a given problem.   4   4   1

22. What is the best-case time complexity of the insertion sort algorithm, and when does it occur?   4   1   1

23. What is the brute force method, and how does it differ from heuristics?   4   1   2

24. What is the greedy approach in algorithm design, and what are its advantages and disadvantages?   4   1   2

25. What are traversal algorithms in data structures, and what are the different types of traversal algorithms?   4   1   3

26. What is the difference between P-type and NP-type problems, and what does it mean for a problem to be NP-complete?   4   1   4

27. How does an approximation algorithm differ from an exact algorithm? Provide an example of a problem that can be solved using an approximation algorithm, and explain how it works.   4   4   5