B.Tech. DEGREE EXAMINATION, DECEMBER 2023
Fourth Semester

18CSC204J – DESIGN AND ANALYSIS OF ALGORITHMS
(For the candidates admitted from the academic year 2020-2021 & 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 40th minute.
(ii)   **Part - B & Part - C** should be answered in answer booklet.

Time: 3 hours   Max. Marks: 100

PART – A (20 × 1 = 20 Marks)
Answer ALL Questions

		Marks	BL	CO	PO

1. _____ within the limit deals with the behavior of a function for sufficiently large values of its parameter.   (1, 1, 1, 2)
   (A) Asymptotic notation
   (B) Big-oh notation
   (C) Omega notation
   (D) Theta notation

2. There are four algorithms A_1, A_2, A_3, A_4 to solve the given problem with the order n, n^2, $n^2 \log n$ and 2^n respectively. Which is the worst algorithm?   (1, 2, 1, 2)
   (A) A_1
   (B) A_2
   (C) A_3
   (D) A_4

3. How many number of comparison are required in insertion sort if the file is already sorted?   (1, 2, 1, 2)
   (A) N
   (B) N – 1
   (C) N + 1
   (D) N^2

4. Which of the following recurrence relations can be used to find the nth Fibonacci number?   (1, 2, 1, 2)
   (A) $f(n) = f(n) + f(n-1)$
   (B) $f(n) = f(n) + f(n+1)$
   (C) $f(n) = f(n-1)$
   (D) $f(n) = f(n-1) + f(n-2)$

5. The algorithm which has time complexity of $O(n \log n)$ for best, worst and average cases is _____.   (1, 1, 2, 2)
   (A) Merge sort
   (B) Quick sort
   (C) Insertion sort
   (D) Selection sort

6. The recurrence relation for finding maximum and minimum elements from an array using divide and conquer technique is T(n) =   (1, 2, 2, 2)
   (A) $2T(n/2) + n$
   (B) $4T(n/2) + n^2$
   (C) $2T(n/2) + 2$
   (D) $3T(n/2) + 1$

7. Time complexity of Strassen's matrix multiplication problem is _____.   (1, 1, 2, 2)
   (A) $T = \theta(N^{\log 2})$
   (B) $T = \theta(7^{\log 2})$
   (C) $T = \theta(7^{\log n})$
   (D) $T = \theta(N^{\log 7})$

8. In divide and conquer, to solve a problem recursively by applying three steps at each level of the recursion are _____.
   (A) Divide, collide and conquer
   (B) Divide, conquer and combine
   (C) Divide, collect and conquer
   (D) Divide, combination and conquer

9. Traverse left subtree, visit the root and traverse right subtree is _____.
   (A) In order traversal
   (B) Preorder traversal
   (C) Post order traversal
   (D) Breadth first traversal

10. Which of the following is a variable length encoding method?
    (A) ASCII code
    (B) EBCDIC code
    (C) Grey code
    (D) Huffman code

11. Recognize the best approach to perform matrix chain multiplication.
    (A) Dynamic programming
    (B) Branch and bound
    (C) Backtracking
    (D) Divide and conquer

12. Time complexity of longest common subsequence using dynamic programming is _____.
    (A) O (m!)
    (B) O (mn)
    (C) O (n!)
    (D) O (n)

13. Backtracking algorithm is implemented by constructing a tree of choices called as?
    (A) State-space tree
    (B) State-chart tree
    (C) Node tree
    (D) Backtracking tree

14. What is the time complexity of depth first search?
    (A) O (V + E)
    (B) O (E)
    (C) O (V)
    (D) O (V * E)

15. Which of the following is not a branch and bound strategy to generate branches?
    (A) LIFO branch and bound
    (B) FIFO branch and bound
    (C) Lowest cost branch and bound
    (D) Highest cost branch and bound

16. The data structure used in standard implementation of breadth first search is?
    (A) Stack
    (B) Queue
    (C) Tree
    (D) Linked list

17. What is the purpose of using randomized quick sort over standard quick sort?
    (A) So as to avoid worst case space complexity
    (B) So as to avoid worst case time complexity
    (C) To improve accuracy of output
    (D) To improve average case time complexity

18. _____ is the class of decision problems that can be solved by non-deterministic polynomial algorithm.
    (A) NP
    (B) P
    (C) Hard
    (D) Complete

19. A random algorithm uses random bits as input in order to achieve a _____ good performance overall possible choice of random bits.
    (A) Worst case
   (B) Best case
    (C) Average case
    (D) Best and worst case

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20. A _____ of a graph is a set of vertices that includes at least one endpoint of every edge of the graph.

(A) Vertex traversal (B) Preorder traversal
(C) Vertex cover (D) In-order cover

PART – B (5 × 4 = 20 Marks)
Answer ANY FIVE Questions

Marks BL CO PO

21. Write short note on fundamentals of algorithmic problem solving.

4   3   1   2

22. Find the upper and lower bound of running time of a given polynomial function.

$$f(n) = 3n^3 + 3n + 4;$$
$$g(n) = n^3$$

4   3   1   2

23. Write the algorithm for iterative binary search. Mention its worst case time complexity.

4   3   2   2

24. Solve the recurrence relation using master's theorem.

(i) $T(n) = 3T(n/2) + n^2$
(ii) $T(n) = 2T(n/2) + n\log n$

4   3   2   2

25. Compute a minimum spanning tree for the graph of figure using Kruskal's algorithm.

4   3   3   2
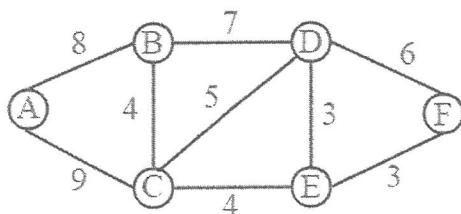
26. Write an algorithm for N-queen's problem.

4   3   4   2

27. Explain briefly about the complexity classes of P and NP?

4   3   5   2

PART – C (5 × 12 = 60 Marks)
Answer ALL Questions

Marks BL CO PO

28. a. Determine the time complexity by generating a recurrence relation of a given pseudo code.

```
fun check (int x)
{
 if (x > 0)
  {
    printf ("%d", x);
    check (x–1);
    check (x–1);
  }
  }
```

(OR)

b. We have a list of pairs [("Ashwin", 82), ("Sumathi", 12), ("Tanuja", 59), ("Brindha", 45), ("Shabana", 72), ("Viday", 51)], where each pair consist of a student's name and his/her marks in a course. Suggest the suitable sorting algorithm to sort all the marks that would take lesser number of swaps and also explain the best - and worst - case scenarios with time complexities.   12   3   1   2

29. a. Apply the sorting technique which has the worst case time complexity as $O(n \log n)$ on the following sequence 17, 8, 7, 19, 24, 10, 14, 23 and also analyse the time complexity. Perform the dry run for the given example.   12   3   2   2

(OR)

b. Illustrate the maximum sub array sum problem for the following array elements 8, 4, –1, 9, 6, –2, –3, 10, 2 using divide and conquer method. Write the pseudo code and mention its worst case time complexity.   12   3   2   2

30. a. Let $A = \{a\,/\,2, b\,/\,3, c\,/\,5, d\,/\,7, E\,/\,9, F\,/\,13\}$ be the letters and its frequency distribution in a text file. Write an algorithm of Huffman coding and compute a suitable Huffman coding to compress the data effectively and also compute optimal cost.   12   3   3   2

(OR)

b. Let there be a Knapsack with capacity W = 5 kg. There are 4 items with whose profit and weight are given in the table. Find the optimal order for loading the items in the given Knapsack using dynamic programming approach.   12   3   3   2

Items	1	2	3	4
Weight	3	2	4	1
Profit	100	20	60	40

31. a. Given a set of cities and the distance between every pair of cities, the problem is to find the shortest possible route using branch and bound method that visits every city exactly once and returns to the starting point.   12   3   4   2

	A	B	C	D
A	∞	4	12	7
B	5	∞	∞	18
C	11	∞	∞	6
D	10	2	3	∞

(OR)

b. Consider the sum-of-subset problem n = 4, sum = 13 and $w_1 = 3$, $w_2 = 4$, $w_3 = 5$ and $w_4 = 6$. Find a solution to the problem using backtracking. Show the state-space tree leading to the solution. Also, the number of nodes in the tree in the order of recursion calls.   12   3   4   2

32. a. Babu has six different sets of notebooks where his task is to arrange the note books in an ascending order. A list of unsorted notebooks is: 78, 23, 45, 32, 36, 8. Use randomized quick sort algorithm to sort the note books with $O(n \log n)$ complexity.   12   3   5   2

(OR)

b. Write Rabin-Karp algorithm and perform pattern matching for the following using Rabin-Karp algorithm.   12   3   5   2
        String: a b c c d d a e f g
        Pattern: c d d

* * * * *