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B.Tech DEGREE EXAMINATION, NOVEMBER 2023

Seventh Semester

18CSE486T - ADVANCED ALGORITHMS

(For the candidates admitted during 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** and **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
1.	Find the algorithm which operates based on the divide and conquer approach. (A) Merge sort (B) Bubble sort (C) Selection sor (D) d	1	1	1
2.	Identify the recurrence for the worst case of Quicksort and its worst-case time complexity. (A) a. $T(n) = T(n-2) + O(n)$ and $O(n^2)$ (B) $T(n) = T(n-1) + O(n)$ and $O(n^2)$ (C) a. $T(n) = 2T(n/2) + O(n)$ and $O(n \log n)$ (D) $T(n) = T(n/10) + T(9n/10) + O(n)$ and $O(n \log n)$	1	2	1
3.	Consider the algorithms which sort the input sequences in ascending order. If the input is already in ascending order, which of the following is TRUE? (A) Quick sort runs in $\theta(n^2)$ time (B) Merge sort runs in $\theta(n)$ time (C) Insertion sort runs in $\theta(n^2)$ time (D) Bubble sort runs in $\theta(n^2)$ time	1	1	1
4.	Consider the recurrence relation where c is a positive constant. $T(n) = T(n/4) + T(n/2) + cn2$ where $T(1)= c$ and $T(0)= 0$. Find the time complexity. (A) $O(n^3)$ (B) $O(n^2)$ (C) $O(n^2 \log n)$ (D) $O(n \log n)$	1	3	1
5.	Consider a normal queue that is implemented using an array of size M. The queue gets full when _____ (A) Rear = M – 1 (B) Front = (rear + 1) mod M (C) Front = rear + 1 (D) Rear = front	1	1	2
6.	Identify the operations that could be performed in O(log n) time complexity by red-black tree. (A) Sorting (B) Insertion only (C) Insertion, deletion, finding predecessor, successor (D) Finding predecessor and successor only	1	1	2
7.	_____ of the following is not a collision resolution strategy for open addressing. (A) Linear probing (B) Quadratic probing (C) Double hashing (D) Rehashing	1	1	2

8. Consider the numbers 7, 5, 1, 8, 3, 6, 0, 9, 4, 2 are inserted in the given order into an empty binary search tree (BST). The BST uses the usual ordering on natural numbers. Find the in-order traversal sequence of the resultant tree. 1 3 2

(A) 7 5 1 0 3 2 4 6 8 9
(B) 0 2 4 3 1 6 5 9 8 7
(C) 0 1 2 3 4 5 6 7 8 9
(D) 9 8 6 4 2 3 0 1 5 7

9. _____ of the following algorithms is used most efficiently to find whether a cycle is present in a graph. 1 1 3

(A) Prim's algorithm
(B) Kruskal's algorithm
(C) Breadth First Search
(D) Depth First Search

10. Find the correct statement. 1 2 3

(A) Prim's algorithm can also be used for disconnected graphs
(B) Kruskal's algorithm can also run on the disconnected graphs
(C) Prim's algorithm is simpler than Kruskal's algorithm
(D) In Kruskal's sort the edges are added to MST in decreasing order of their weights

11. Prims's algorithm is a _____ 1 1 3

(A) divide and conquer algorithm
(B) dynamic programming algorithm
(C) greedy algorithm
(D) approximation algorithm

12. Identify the running time of Bellmann Ford Algorithm where V is number of vertices and E is number of edges in the graph. 1 2 3

(A) O(V E)
(B) $O(V^2)$
(C) O(E log V)
(D) O(V)

13. The traveling salesman problem can be solved using _____ 1 2 4

(A) Bellman-Ford algorithm
(B) A spanning tree
(C) A minimum spanning tree
(D) DFS traversal

14. Choose the worst-case complexity of Knuth-Morris-Pratt algorithm for pattern searching (m=length of text and n=length of pattern) 1 2 4

(A) O(nm)
(B) O(log n)
(C) O(n)
(D) O(m)

15. The subset sum problem is _____ 1 2 4

(A) Finding the sum of elements present in a set
(B) Finding the sum of all the subsets of a set
(C) Checking for the presence of a subset that has sum of elements equal to a given number and printing true or false based on the result
(D) Finding a subset of a set that has sum of elements equal to a given number

16. Greedy algorithm finds a minimal vertex cover in polynomial time for _____ 1 2 4

(A) Tree graphs
(B) Bipartite graphs
(C) Trees only
(D) Directed graphs

17. Let A be an NP-complete problem. Let B and C be two other problems not known to be in NP. C is polynomial time reducible to A and A is polynomial time reducible to C. Identify the correct option from the following: 1 3 5

(A) B is NP-complete
(B) B is NP-hard
(C) C is NP-complete
(D) C is NP-hard

18. CNF-satisfiability problem belongs to _____ 1 1 5

(A) P class
(B) NP complete
(C) NP hard
(D) NP class

19.	Find the number of conditions must be met if an NP-complete problem is polynomial reducible. (A) 1 (B) 2 (C) 3 (D) 4	1	1	5
20.	Consider two decision problems Q1 and Q2 such that Q1 reduces in polynomial time to 3-SAT (Boolean Satisfiability Problem) and 3-SAT reduces in polynomial time to Q2. Find the one which is consistent with this statement. (A) Q1 is NP and Q2 is in NP-hard (B) Q2 is NP and Q1 is in NP-hard (C) Both Q1 and Q2 are in NP (D) Both Q1 and Q2 are in NP-hard	1	3	5

PART - B (5 × 4 = 20 Marks)

Answer **any 5** Questions

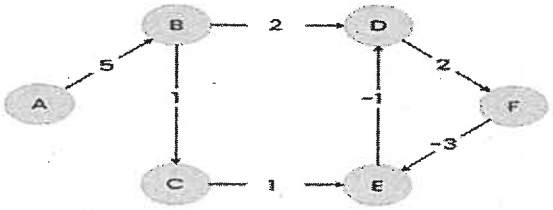
		Marks	BL	CO
21.	Write binary search algorithm and discuss the complexity analysis of binary search.	4	2	1
22.	Write Quick sort algorithm. Consider the numbers 24, 9, 29, 14, 19, 27, Apply Quick sort algorithm and analyze its best and worst case complexities.	4	3	1
23.	Explain stack operations using linked list with pseudocode and examples.	4	3	2
24.	Write the properties and construct Red-Black tree for the given list: 7, 18, 3, 22, 26, 10, 8, 11	4	3	2
25.	Compare Breadth First Search and Depth First Search algorithms.	4	2	3
26.	Write Vertex cover algorithm and give an example.	4	3	4
27.	Brief about NP-Hard and NP-Complete with an example.	4	1	5

PART - C (5 × 12 = 60 Marks)

Answer **all** Questions

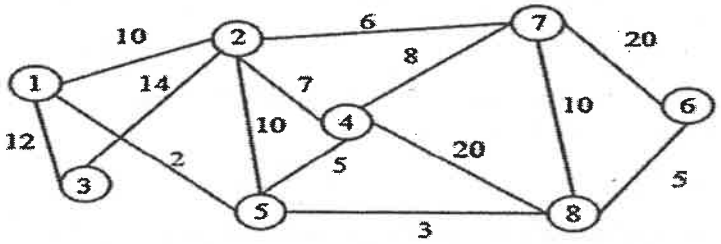
		Marks	BL	CO
28.	(a) Consider the recurrence relation $T(n)= \begin{cases} 1 & \text{if } n=1 \\ 4T(n/2)+n^2 & \text{if } n>1 \end{cases}$ Solve the above recurrence relation by all three methods. **(OR)** (b) Consider the recurrence relation $T(n)= \begin{cases} 1 & \text{if } n=1 \\ T(n/2)+n & \text{if } n>1 \end{cases}$ Solve the above recurrence relation by all three methods.	12	5	1
29.	(a) Discuss in detail about the Extendible hashing technique with suitable example. **(OR)** (b) Explain in detail about the Linear Linked list with its pseudocode. Give an example of insertion and deletion of an element in the middle.	12	2	2

30. (a) Consider the following graph. Apply Bellman-Ford's algorithm and discuss the result. 12 4 3

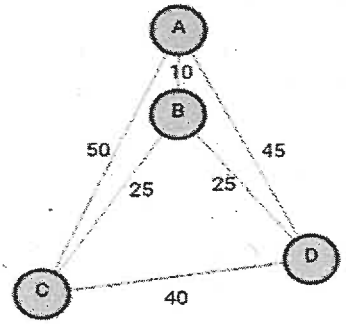


(OR)

(b) Consider the undirected graph given below. Explain and construct a minimum spanning tree using Prim's and Kruskal's algorithms.



31. (a) Consider the below graph G. Let A be the starting vertex. Visit all the nodes of G using Travelling Salesman Problem (TSP). Explain the TSP algorithm in detail and identify the technique used in TSP. 12 3 4



(OR)

(b) Discuss the sum of subset algorithm. Consider the set S={5,10,12,13,15,18} and find the subset with total=30

32. (a) Discuss P and NP classes, NP-Hard, and NP-Complete in detail with suitable examples. 12 2 5

(OR)

(b) Explain the 3CNF (Conjunctive Normal Form) satisfiability problem with an example.

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