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Subject Code:- ACSE0401

Roll. No: 2 0 0

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: IV - THEORY EXAMINATION (2021 - 2022)

Subject: Design and Analysis of Algorithm

Time: 3 Hours

Max. Marks: 100

General Instructions:

1. The question paper comprises three sections, A, B, and C. You are expected to answer them as directed.
2. Section A - Question No- 1 is 1 marker & Question No- 2 carries 2 mark each.
3. Section B - Question No-3 is based on external choice carrying 6 marks each.
4. Section C - Questions No. 4-8 are within unit choice questions carrying 10 marks each.
5. 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. The worst case complexity for insertion sort is (CO1) 1

(a) O(n)
(b) O(log n)
(c) O(nlog n)
(d) $O(n^2)$

1-b. Suppose we are sorting an array of eight integers using heapsort, and we have just finished some heapify (either maxheapify or minheapify) operations. The array now looks like this: 16 14 15 10 12 27 28 How many heapify operations have been performed on root of heap? (CO1) 1

(a) 1
(b) 2
(c) 3 or 4
(d) 5 or 6

1-c. No of fields in a node of Binomial heap are (CO2) 1

(a) 4
(b) 5
(c) 6
(d) 7

1-d. Given a heap of n nodes, the maximum number of tree for building the heap is (CO2) 1

(a) n
(b) n-1
(c) n/2
(d) log n

1-e. We can solve Single-Source shortest path problem using (CO3) 1

(a) Kruskal's Algorithm
(b) Prim's Algorithm
(c) Dijkstra's Algorithm
(d) Flyod-Warshal Algorithm

1-f. For dense graph which of the following statement is true (CO3) 1

(a) V = E^2
(b) E < |V|

(c) E = 2 |V|
(d) E = V^2

1-g. If an optimal solution can be created for a problem by constructing optimal solutions for its subproblems, the problem possesses _____ property. (CO4) 1

(a) Overlapping subproblems
(b) Optimal substructure
(c) Memoization
(d) Greedy

1-h. Which of the following is true about the time complexity of the recursive solution of the subset sum problem? (CO4) 1

(a) It has an exponential time complexity
(b) It has a linear time complexity
(c) It has a logarithmic time complexity
(d) it has a time complexity of O(n2)

1-i. Problems that can be solved in polynomial time are known as? (CO5) 1

(a) intractable
(b) tractable
(c) decision
(d) complete

1-j. A randomized algorithm uses random bits as input inorder to achieve a _____ good performance over all possible choice of random bits. (CO5) 1

(a) worst case
(b) best case
(c) average case
(d) none of the mentioned

2. Attempt all parts:-

2.a. Rank the following functions according to their order of growth. (CO1) 2
n^2, n, lgn, nlgn, n! , 2^n, $n^{1/2}$,n^n, n^2logn

2.b. Discuss the applications of Fibonacci Heap (CO2) 2

2.c. Explain different types of edges obtained during DFS Traversal on a directed graph (CO3) 2

2.d. Explain N-Queen problem with its complexity? (CO4) 2

2.e. Explain Approximation Algorithm. (CO5) 2

SECTION B

3. Answer any five of the following:- 30

3-a. Solve the following recurrence relation using master's theorem (CO1) 6
$T(n) = 7T(n/2) + 3n^2 + 2$

3-b. What is a priority queue? Explain key operations of priority queue With the help of an example. (CO1) 6

3-c. Insert the nodes 15, 13, 12, 16, 19, 23, 5, 8 into empty Red Black Tree (CO2) 6

3-d. Explain the algorithm to delete a given element in a binomial Heap. Give an example for the same. (CO2) 6

3.e. Write algorithm to solve fractional knapsack problem. For the given items, find the optimal solution: W: <6, 2, 4, 3, 5>, P: <12, 10, 9, 9, 5>, capacity of knapsack = 10 (CO3) 6

3.f. Find Longest Common Subsequence of sequences "ALLIGATOR" and "ALGORITHM" using dynamic programming. (CO4) 6

3.g. What is randomized algorithms? Explain the concept behind randomized algorithms? (CO5) 6

4. Answer any one of the following:-

4-a. Write the algorithm of Counting sort? Sort the following elements using Counting sort algorithm <4, 8, 4, 2, 9, 9, 6, 2, 9> (CO1) 10

4-b. Find the time complexity of following recurrence relation using recursion tree (CO1) 10
$T(n)=2T(n^{1/2})+\log n$

5. Answer any one of the following:-

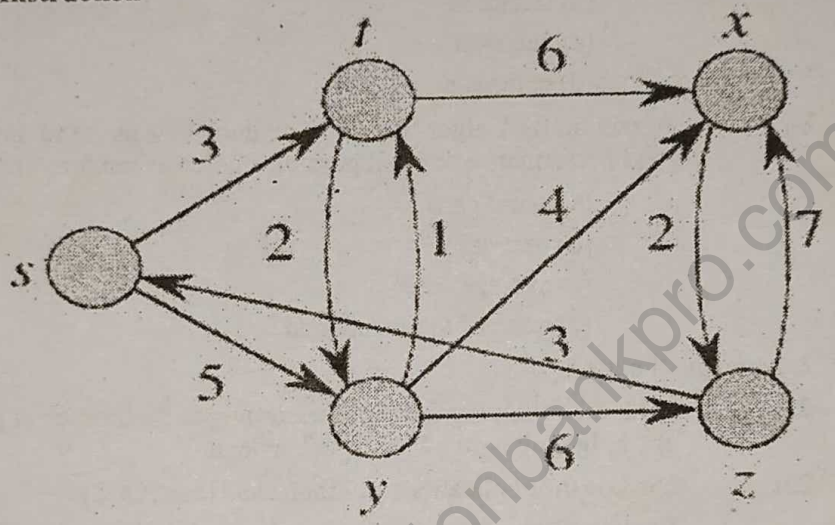
5-a. Write algorithm for extracting minimum element in a fibonacci heap. Also give example? (CO2) 10

5-b. Using minimum degree 't' as 3, insert following sequence of integers 10, 25,20, 35, 30, 55, 40, 45, 50, 55, 60, 75, 70, 65, 80, 85 and 90 in an initially empty B-Tree. Give the number of nodes splitting operations that take place (CO2) 10

6. Answer any one of the following:-

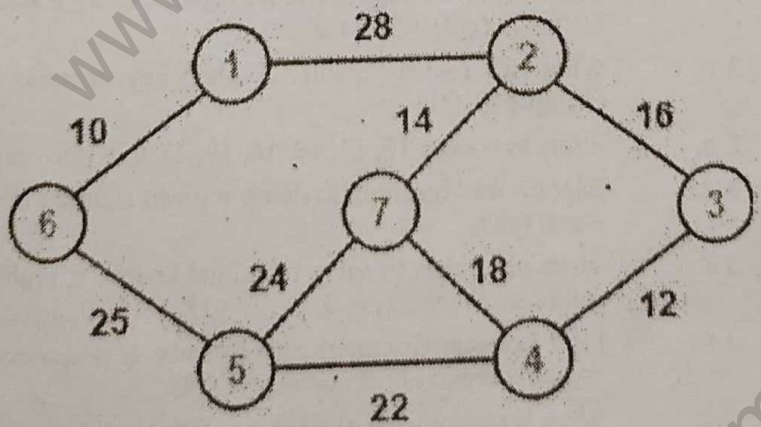
6-a. Explain "single-source shortest path" problem. Implement an algorithm to solve single source shortest path problem when edges have positive weight only. Taking vertex 'S' as source vertex, solve the problem for the given graph. (CO3) 10

Question Instruction



6-b. Implement Prim's algorithm to find minimum spanning tree. Analyze its time complexity. Find MST of the given graph using Prim's algorithm. (CO3) 10

Question Instruction



7. Answer any <u>one</u> of the following:-

7-a. Consider the sum-of-subset problem, n = 4, Sum = 13, and w1 = 3, w2 = 4, w3 = 5 and w4 = 6. Find a solution to the problem using backtracking. Show the state-space tree leading to the solution. (CO4) 10

7-b. Solve the instance of 0/1 knapsack problem using dynamic Programming : n = 4, M = 25, (P1, P2, P3 P4) = (10, 12, 14, 16), (W1, W2, W3, W4) = (9, 8, 12, 14) (CO4) 10

8. Answer any <u>one</u> of the following:-

8-a. Define the following problems related to NPC: (CO5) 10
(i) Vertex Cover
(ii) Clique
(iii) SAT and its variants

8-b. Explain the KMP String matching algorithm for finding the pattern on a text and analyze the algorithm. (CO5) 10