Question Paper

Exam Date & Time: 24-May-2023 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

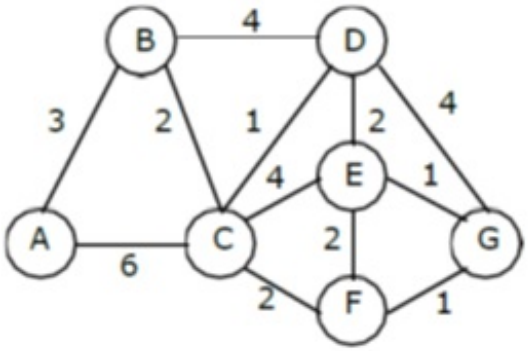
FOURTH SEMESTER B.TECH. (INFORMATION TECHNOLOGY) DEGREE EXAMINATIONS - MAY/JUNE 2023
SUBJECT: ICT 2257/IT_2257 - DESIGN AND ANALYSIS OF ALGORITHMS

Marks: 50 **Duration: 180 mins.**

Answer all the questions.

Missing data, if any, may be suitable assumed.

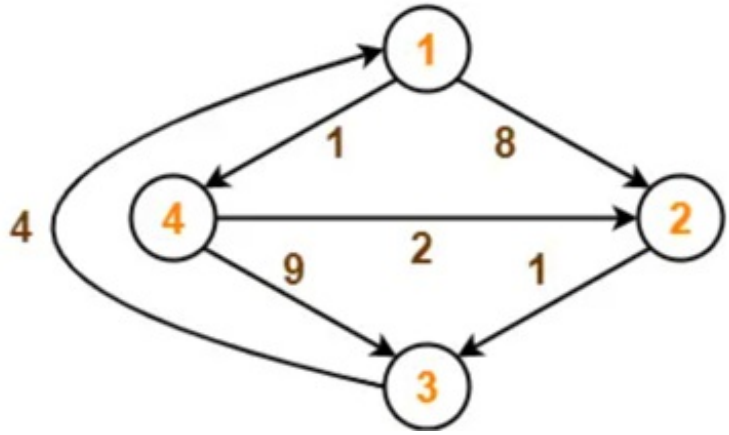
1A) Devise the Prim's Algorithm using heap to find a minimal spanning tree for the graph shown below starting with the vertex A. Also show the steps wise progress using the devised algorithms clearly and Mention the Bounding conditions of the Prim's Algorithm. (5)



1B) Given Profit P:{ 45, 30, 45, 10} (3)
Weight W:{ 3, 5, 9, 5}
Capacity C =16
Use branch and bound to find the items that can maximize the profit when packed into the knapsack without exceeding its limit. Make use of appropriate bounding function.

1C) Given a set of n items, each with a weight and a value, and a knapsack with a capacity of W, find a subset of items that maximizes the total value without exceeding the total weight. Show how to prove that this problem is NP-complete. (2)

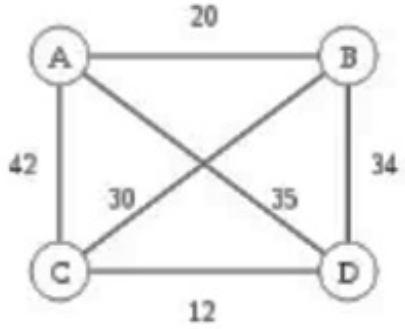
2A) Consider the following directed weighted graph- (5)



Design and by Using Floyd Warshall Algorithm, find the shortest path distance between every pair

of vertices. Mention the complexity of the Floyd Warshall Algorithm.

2B) Apply the Approximation algorithm for Travelling Salesperson Problem and find the path cost for the given problem. Trace the time complexity of the algorithm. (3)

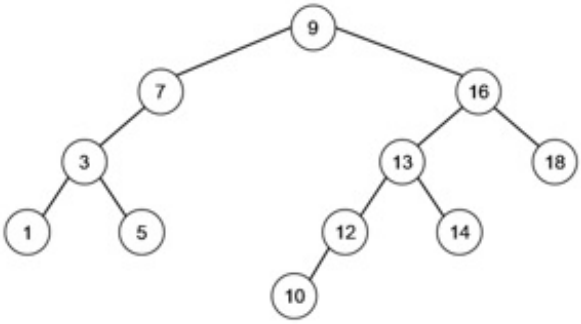


2C) Prove or disprove the following equalities using the formal definition of the corresponding asymptotic notation and also using limits theorem (2)

- $n^2/\log n = \theta(n^2)$
- $f(n) = \sum_1^n i^2 , g(n) = \omega(n)$

3A) Consider a double hashing scheme in which the primary hash function is h1(k)=k mod 9, and the secondary hash function is h2(k)=1+(k mod 6). Assume that the table size is 9. After three iterations of the second hashing function that did not find the empty position, apply an alternative technique to solve and find the position for all the key elements 5, 8, 3, 2, 6, 11, 13, 7, 12, 10. (5)

3B) Providing the suitable reasons identify the nodes that violate the height invariant in the AVL tree given in Fig. 3B. (3)



3C) In what order, n matrices A_1, A_2, A_3, ... A_n should be multiplied so that it would take a minimum number of computations to derive the result. (2)

4A) i) Devise and analyse the recursive divide and conquer strategy to find the maximum and minimum elements among the list of the elements from the given array of the elements 22, 13, -5, -8, 15, 60, 17, 31, 47 respectively, also construct the tree by adding a node when a new recursive call is made, by showing the steps clearly and trace the algorithm. Devise the Recurrence Equations for the designed algorithm and solve the recurrence equation using back substitution method. (5)
ii) State the Master's Theorem to solve the recurrence equation.

4B) Derive the time complexity recurrence relation for the following code and solve it using substitution method. Also find the space complexity for the same. (3)

```
1. int recursive (int n)
2. {
3. if (n == 1)
4. return (1);
5. else
6. return (recursive (n-1) + recursive (n-1));
7. }
```

4C) Construct a hash table using linear probing for the following values: 23, 21, 18, 40, 31, 48, 66, 28, (2)

30, 34. Assume the table size is 12 and the primary hash function is h(k) = k % 12.

5A) i) Calculate the Maximum possible number of nodes in AVL tree of height-3. (5)

ii) For the AVL tree in Fig 5A1, what is the result AVL tree after we remove the element 35?

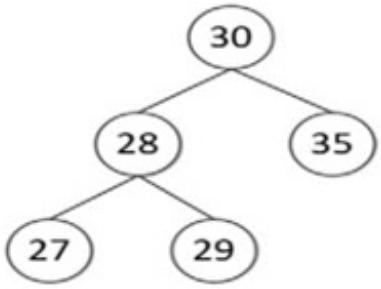


Fig 5A1

iii) What is resulting AVL tree after we insert the element 17 into the AVL tree Fig 5A2,

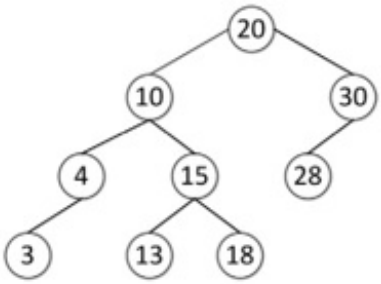


Fig 5A2

5B) Design and Analyse the back tracking algorithm to solve the Knapsack 0/1 Problem and give the Time complexity of the algorithm. (3)

5C) Give one example each for best and worst case for BFS and DFS. Justify, on what basis the examples are considered as best and worst case for BFS and DFS. (2)

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