Ref No: Ex/IT/PC/B/T/321/2023(S)

**B.E. INFORMATION TECHNOLOGY THIRD YEAR SECOND SEMESTER SUPPLEMENTARY EXAM - 2023**

**DESIGN & ANALYSIS OF ALGORITHM**

**Time: Three Hours** **Full Marks: 100**

*Different parts of the same question should be answered together*

**CO1**

1. **Answer any *one* question**

A. (a) Give example of a linear and a non-linear data structures.

(b) Why do we use asymptotic notations in the study of algorithms? Compute time complexity of the given recurrence relations

(i) $T(n)=2T(n/2)+\sqrt{n}$

(ii) $T(n)=3T(n/2)+ n$

(c) Construct an AVL tree with following key set 5, 7, 12, 15, 2, 4, 13, 20, 18, 19 (maintaining the order).

3+3+3+2+2+7=20

B. (a) When do we need tree and graph data structure to store data? Explain both with example. Define big o (O) and theta ($\theta$) notation with graphical representation.

(b) Discuss on the data structures you will use for representing a complete graph with 7 nodes and a complete binary tree with 10 nodes. (4+4+2+2+2+3+3=20)

**CO2**

2. (a) What do you mean by greedy approach? "The greedy approach always gives an optimal solution" the statement is true or false? Justify your answer with example.

(b) What is advantage of dynamic programming over divide and conquer approach?

(c) Differentiate between backtracking and branch & bound algorithm strategy

4+2+4=10

## CO3

3. Answer *any* three questions

A. Explain a divide and conquer algorithm for sorting n numbers. Compute complexity. 8+2=10

B. What is Longest Common Subsequence (LCS) between two string X and Y. Compute the LCS between the string X = "horseback" and Y = "snowflake" using dynamic programming technique. 2+8=10

C. What do you mean by N-queen problem? Give the solutions of 4-queen problem. 10

D. Solve following fractional Knapsack Problem using greedy approach where m=16, n=6, P=(2, 6, 8, 1, 3, 5), W=(10, 6, 5, 3, 1, 3).

## CO4

4. (a) What are the differences between linear search and binary search? Do you search an element from a dataset in constant time?

(b) Derive the average case time complexity for quicksort algorithm. When do you call a sorting algorithm stable or unstable? Explain it with example.

(c) The keys 12, 18, 13, 2, 3, 23, 5 and 15 are inserted into an initially empty hash table of length 10 using open addressing with hash function h(k) = k mod 10 and linear probing. What is the resultant hash table? (2+1)+(5+3)+4=15

## CO5

5. Answer *any* one question

A. **Compute the shortest path from the source vertex (K) to destination vertex (L) for the given graph in Fig. 1 using Dijkstra's algorithm.** 15

B. Compute the Minimum Spanning tree (MST) of the given graph in Fig. 2 using Kruskal's algorithm. Derive the time complexity of Kruskal's algorithm. 15

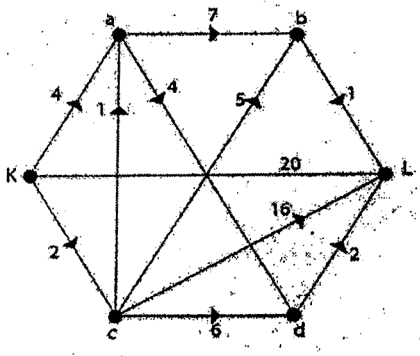


Fig. 1

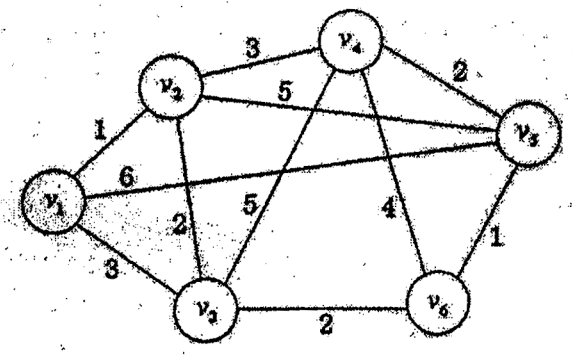


Fig. 2

**CO6**

6. (a) Define NP-Hard and NP Complete Problem.

(b) Prove that complete subgraph problem (CSP) is a NP-Complete problem

or

Prove that 3-SAT problem is a NP-Complete problem (3+2)+5=10

**CO1:** Recollect notations for algorithm analysis and basic data structures and assess the performance of the associated operations (K3)

**CO2:** Illustrate and sketch different algorithmic paradigms to solve problems and analyze them (K3)

**CO3:** Apply different algorithmic techniques to solve the problems (K4)

**CO4:** Analyze, compare and differentiate the behavior of sorting/searching algorithms under different cases and solve the problem. (K4)

**CO5:** Analyze, compare and distinguish the different graph and geometric algorithms and solve problems (K4)

**CO6:** Describe and express the concept of NP-completeness and Approximation algorithms. (K2)