

**B.E. INFORMATION TECHNOLOGY THIRD YEAR SECOND SEMESTER EXAM
2019**

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) Differentiate between linear and non-linear data structures with example.
- (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) $T(n) = 3T(n/2) + n$
- (iii) $T(n) = \sqrt{2}T(n/2) + \log n$
- (c) Construct an AVL tree with following key set 5, 7, 12, 15, 2, 4, 13, 20, 18, 19 (maintaining the order). Delete 7, 5 and 18 one by one from the constructed AVL tree.
3+(1+6)+10=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 (θ) notation with graphical representation.
- (b) What are the differences between AVL tree and Red Black tree with example?
- (c) Construct a Red-Black tree with following key set 4, 7, 12, 15, 3, 5, 14, 18, 16, 17 (maintaining the order).
(3+3)+4+10=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. Briefly explain Strassen's matrix multiplication and how it uses divide and conquer method. Obtain its time complexity. 8+2=10
- B. What is the string edit distance between two strings X and Y. Compute the string edit distance between the string X = "JADAVPUR" and Y = "JALPAIGURI" using dynamic programming technique. 2+8=10
- C. 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
- D. What do you mean by N-queen problem? Give the solutions of 4-queen problem. Solve following fractional Knapsack Problem using greedy approach where $m=16$, $n=6$, $P=(2, 6, 8, 1, 3, 5)$, $W=(10, 6, 5, 3, 1, 3)$ 3+7=10

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 $h(k) = k \bmod 10$ 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. 10
- 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. 10

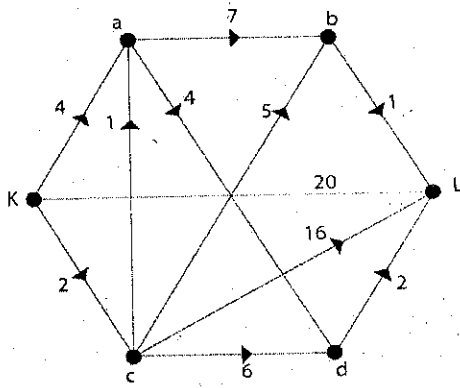


Fig. 1

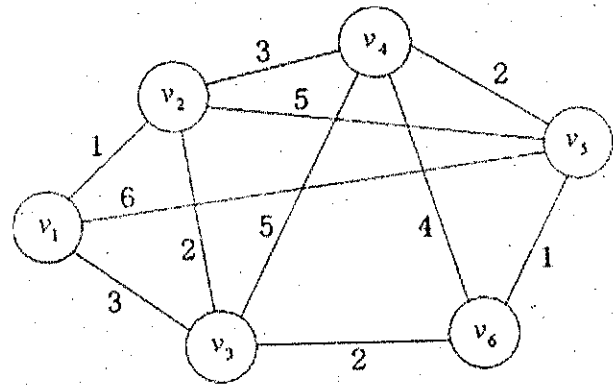


Fig. 2

CO6

6. (a) Define NP-Hard and NP Complete Problem. State the Cook's theorem. What is the reduction of a problem to another problem?
- (b) Prove that complete subgraph problem (CSP) is a NP-Complete problem
or
Prove that 3-SAT problem is a NP-Complete problem (2+1+2)+10=15

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)