05/12/14
1st half

CS-501

DESIGN AND ANALYSIS OF ALGORITHM

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP A
(Multiple Choice Type Questions)

1. Answer any *ten* questions. $10 \times 1 = 10$

(i) Minimum number of color required to color a graph having $n > 3$ vertices and 2 edges is

(A) 2 (B) 3 (C) 4 (D) 1

(ii) An undirected graph G with n vertices and e edges is represented by adjacency list. What is the time required to generate all the connected components?

(A) $O(n)$ (B) $O(e)$ (C) $O(e+n)$ (D) $O(e^2)$

(iii) An adjacency matrix representation of a graph cannot contain information of

(A) nodes (B) edges
(C) direction of edges (D) parallel edges

(iv) An algorithm is made up of two independent time complexities $f(n)$and $g(n)$. Then the complexities of the algorithm is in the order of

(A) $f(n) \times g(n)$ (B) max $(f(n), g(n))$
(C) min $(f(n), g(n))$ (D) $f(n) + g(n)$

(v) Match the following

(a) Fractional Knapsack	(i) Greedy Algorithm
(b) 0-1 Knapsack	(ii) Dynamic Programming Algorithm

(A) a-i and b-i (B) a-i and b-ii

(C) a-ii and b-i (D) a-ii and b-ii

(vi) The average number of comparisons performed by merge sort algorithm in merging two sorted lists of 2 elements is

(A) 8/5 (B) 11/7 (C) 11/6 (D) 8/3

(vii) The data structure required for Breadth First Traversal on a graph is

(A) queue (B) stack (C) array (D) tree

(viii) Which of the following sorting methods would be most suitable for sorting a list which is almost sorted

(A) bubble sort (B) insertion sort

(C) selection sort (D) quick sort

(ix) Prime's algorithm is an example of

(A) backtracking (B) dynamic programming

(C) greedy method (D) none of these

(x) Which of the following is used to depict the working of algorithm?

(A) flowchart (B) pseudo code

(C) source code (D) all of these

(xi) Which one is true of the following?

(A) all NP hard problems are NP complete

(B) all NP complete problems are NP hard

(C) some NP complete problems are NP hard

(D) none of these

(xii) BFS on a graph has running time

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

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. What do you mean by dynamic programming? Write the algorithm of chain matrix multiplication. 2+3

3. Find the recurrence relation of binary search and derive the time complexity of binary search. 5

4. Why Recursion Tree method is best than the Substitution method for solving a recurrence relation? Find asymptotic upper bound of the following recurrence relation with help of recursion tree method. 2+3

$$T(n) = T(n/4)+T(n/2) + \Theta(n^2)$$

5. Write an algorithm to find a minimum spanning tree (MST) for an undirected graph. Estimate the time complexity of your algorithm. 3+2

6. Given weight vector (15, 25, 35, 45, 55) and the profit vector (10, 20, 30, 40, 50) and a Knapsack of capacity 100, find at least three feasible solutions including optimal one for the Knapsack problem of 5 times. 5

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

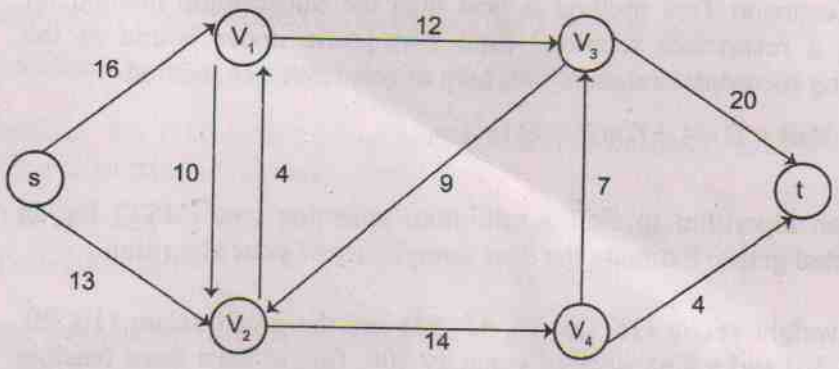
7. Write quicksort algorithm. Analyze the best case and worst case time complexities of your algorithm. Perform the PARTITION operation once (one time) on the following array as per the requirement of the quicksort algorithm, assuming the last element of the array to be the pivot element. Clearly mention the steps. 7+3+5
arr[] = {2, 8, 7, 1, 3, 5, 6, 4}

8. (a) Write the string matching algorithm due to Knuth, Morris and Pratt. Analyze its time complexity. 9+3

(b) Using greedy strategy, schedule the following jobs within deadline so as to maximize the profit. Deadlines and profits are mentioned as follow: 3

Job i	1	2	3	4
Deadline d_i	3	2	3	1
Profit g_i	9	7	7	2

9. State the Max-flow min-cut theorem for network flow analysis. Trace the execution of Ford-Fulkerson algorithm for finding the maximum flow in the following graph. 3+12



10.(a) Define classes P, NP, NP hard and NP-complete and also explain their relationship diagrammatically. What is nondeterministic algorithm? Explain with example. Define circuit satisfiability problem and prove that circuit SAT is in class NP. 4+3+4

(b) Write a short note on approximation algorithm and its uses. 4

11. Write short notes on any *three* of the following: 3×5

(a) Strassen's matrix multiplication.
(b) Kruskal's algorithm for finding MST.
(c) Graph Coloring problem.
(d) Asymptotic notations.
(e) Vertex cover problem.