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MCA
PCS 3001

Third Semester Examination – 2008

ANALYSIS AND DESIGN OF ALGORITHM

Full Marks – 70

Time : 3 Hours

*Answer Question No. 1 which is compulsory
and any **five** from the rest.*

*The figures in the right-hand margin
indicate marks.*

1. Answer the following questions : 2×10
- ✓(a) What are the general characteristic of greedy algorithm ?
 - ✓(b) Construct a MAX-HEAP with the following elements {A, L, G, O, R, I, T, H, M}.

P.T.O.

- (c) Explain why instance characteristic is an important consideration for algorithm complexity ?
- (d) What is the complexity of Prim's algorithm for finding a minimum spanning tree ? Explain.
- (e) How does the principle of optimality reduce the number of decision sequences in dynamic programming algorithms ?
- (f) Using big-O notation, state the average time and space complexity of binary search.
- (g) Solve the following recurrence relation :
 $T(N) = 4T(N-1) + 1$ with $T(1) = 1$ and $T(2) = 3$
- (h) What do you mean by combinatorial problem? Can you find an optimal solution to this problems using dynamic programming ?

- (i) What do you mean by relaxation in the process of designing an approximation algorithm for NP-Hard problem ?
- (j) Define NP-Complete problem with example.
2. (a) What do you mean by complexity of an algorithm ? Derive the asymptotic time complexity of a non recursive, binary search algorithm using divide and conquer approach. 5
- (b) Define approximation algorithms for a problem P. How do you characterize approximation algorithms ? 5
3. (a) State an algorithm to find a minimum-cost path from source to sink in a multistage graph, using backward approach using **dynamic programming** paradigm. 5
- (b) What is brute-force method ? Write a brute-force string matching algorithm. Analyze its complexity. 5

4. ✓(a) Define *subset paradigm* and *ordering paradigm* in the context of greedy approach. Write a greedy algorithm for solving the 0-1 knapsack problem. 5
- ✓(b) Explain the Boyer-Moore algorithm for string matching to match a pattern P in a given string T. 5
5. ✓(a) Write an recursive algorithm for quick sort to. Show that time complexity of average case of quick sort is $T(n) = O(n \log n)$; with instance characteristic n . 5
- ✓(b) Discuss the working of FIFO BANCH AND BOUND algorithm, considering 4-queen problem. 5
6. ✓(a) Explain the role of a criteria function in problem solving process with backtracking algorithm. Suggest the structure of a recursive backtracking algorithm. 5

- ✓(b) Write an algorithm to compute shortest path on a weighted, undirected, and connected graph. Comment on complexity of the algorithm. 5
7. ✓(a) Describe and justify Kruskal's algorithm for finding the minimum spanning tree of an undirected graph. What is the time complexity of Kruskal's algorithm? 5
- (b) What are the four factors that decides the efficiency of the Backtracking Algorithm? Explain the role of rearrangement of search space in performance of Backtracking. 5
8. (a) Arrange the following functions from the lowest asymptotic order to the highest asymptotic order :
- $10n, \log n, 2^{n^3}, 5n^2, 2 \log n, e^n - 2n^3,$
 $7 \log n^2$ 2.5

- (b) Suppose you insert n numbers into an initially empty priority queue (implemented as a heap), what is the worst-case running time? 2.5
- (c) Let G be a weighted, undirected, connected graph with n vertices and at most $100n$ edges, where all the edges have the same weight. Given two vertices u and v in G , how fast can you find a shortest path from u to v ? 2.5
- (d) What is the solution of the recurrence $T(n) = 16T(n/4) + n$, $T(1) = 1$ (assuming n is a power of 4)? 2.5

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