Roll No. | | | | | | | | | | | | **Total No. of Pages : 02**

Total No. of Questions : 18

B.Tech.(CSE) (2011 Onwards) (Sem.–5)

DESIGN & ANALYSIS OF ALGORITHMS

Subject Code : BTCS-503

M.Code : 70536

Time : 3 Hrs. **Max. Marks : 60**

INSTRUCTION TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

Answer the following questions :

1. What is an algorithm?
2. If f(n) = n! and g(n) = 2n, indicate whether f = 0(g), or f = Ω(g), or both (f = θ(g)).
3. What do you mean by dynamic programming?
4. State the time complexity of Bubble sort.
5. Explain the applications of depth first search algorithm.
6. Describe asymptotic notation.
7. What is order statistics?
8. What do you mean by randomization?
9. What is convex hulls?
10. Explain the time complexity of binary search.

SECTION-B

11. Take the following list of functions and arrange them in ascending order of growth rate. That is, if function g(n) immediately follows function f(n) in your list, then it should be the case that f(n) is O(g(n)).

    f1(n) = $n^{2.5}$, f 2(n) = $\sqrt{2}n$, f3(n) = n + 10, f4(n) = 10^n, f5(n) = 100^n, and f6(n) = n^2 log n

12. Sort the list 415, 213, 700, 515, 712, 715 using Merge sort algorithm. Also explain the time complexity of merge sort algorithm.

13. Explain breadth first search algorithm with an example.

14. Write a short note on approximation algorithms.

15. Explain the classes of P and NP.

SECTION-C

16. Explain Strassen's algorithm for matrix multiplication with the help of an example.

17. Write a short note for the following :

    a. Divide and conquer technique

    b. Greedy algorithm

18. a. Why do we perform topological sorts only on DAGs? Explain.

    b. Using Dijkstra's algorithm find the shortest path from A to D for the following graph.

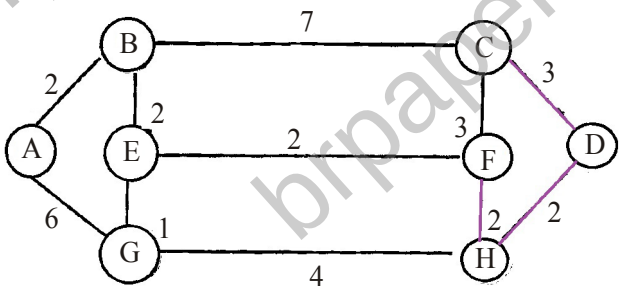

Fig.1

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SECTION-A

Answer the following briefly :

1) What is asymptotic notation?

2) Define Big Oh.

3) What are the steps involved in proving a problem to be NP complete?

4) What are the applications of Fast Fourier transform?

5) How the Prim's algorithm is better in finding the Minimal spanning tree in comparison to the Kruskal's method?

6) What is the time complexity of the algorithm for finding all-pairs-shortest-path problem?

7) What are NP class problems?

8) What is the minimal spanning tree? What are its advantages?

9) What is a deterministic algorithm?

10) Distinguish between deterministic and non-deterministic algorithms.

SECTION-B

11) What is the relationship between the classes P and NP? Explain. (5)

12) Explain the Big -Oh computation for each of the following control structures : (5)

a) Sequencing b) If-then-else c) "for" loop

c) "While" loop e) Recursion

13) What do you analyze in an algorithm? What is the basis of analysis? Explain. (5)

14) Explain topological sort with an example. (5)

15) What are greedy algorithms? What are their characteristics? Explain any greedy algorithm with example. (5)

SECTION-C

16) Explain the KMP algorithm in detail with an illustrative example. (10)

17) Explain in detail quick sorting method. Provide a complete analysis of quick sort. (10)

18) Order the following functions by growth rate: N, $N^{1.5}$, N^2, N log log N, N $\log^2$ N, N log (N^2), 2/N, 2^N, $2^{N/2}$, 37, N^2 log N, N^3 Indicate which functions grow at the same rate. (10)

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SECTION-A

Answer the following briefly :

1) What is closest pair problem?

2) How dynamic programming is used to solve knapsack problem?

3) How time complexity of an algorithm is different from space complexity?

4) Difference between NP, NP complete and NP-hard Problem?

5) Write **any two** applications of Fast Fourier Transform.

6) Write a short note on : Strassen's algorithm.

7) What is 3 SAT problem?

8) What are the applications of BFS?

9) Differentiate between Polynomial and Exponential running time.

10) What is an algorithm?

SECTION-B

11) Bring out the differences between Prim's and Kruskal's algorithm. Also compare with respect to efficiency analysis.

12) Use the substitution method to prove a tight asymptotic lower bound (Ω-notation) on the solution to the recurrence

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

13) Suppose that H[1, ... , n] is an array containing a Min-Heap. Give pseudocode for an algorithm Extract-Min(H, n) that removes the smallest element from the heap H of size n and returns its value. Analyze the time complexity of your algorithm. Explain your algorithm.

14) Suppose we use Dijkstra's greedy, single source shortest path algorithm on an undirected graph. What constraint must we have for the algorithm to work and why?

15) Suppose you were to drive from Delhi to Mumbai. Your gas tank, when full, holds enough gas to travel m miles, and you have a map that gives distances between gas stations along the route. Let $d1<d2<.....<d_n$ be the locations of all the gas stations along the route where d_i is the distance from Delhi to the gas station. You can assume that the distance between neighboring gas stations is at most m miles. Your goal is to make as few gas stops as possible along the way. Give the most efficient algorithm you can find to determine at which gas stations you should stop and prove that your strategy yields an optimal solution. Be sure to give the time complexity of your algorithm as a function of n.

SECTION-C

16) A max heap is given with n elements and its height is log (n). Write an efficient algorithm to find minimum element in heap. Also calculate the time and space complexity.

17) Give the solution for Knapsack with Branch and Bound. The capacity of Knapsack is m = 12. There are 5 objects with profit (p_1,p_2,p_3,p_4,p_5) = (10,15,6,8,4) and weights (w_1,w_2,w_3,w_4,w_5) = (4,6,3,4,2).

18) Write a program for recursive binary search to find the given element within array. For What data binary search is not applicable?

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