Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 77099

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Fourth Semester

Computer Science and Engineering

CS 6402 — DESIGN AND ANALYSIS OF ALGORITHMS

(Common to Information Technology)

(Regulation 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write an algorithm to find the number of binary digits in the binary representation of a positive decimal integer.

2. Write down the properties of asymptotic notations.

3. Design a brute-force algorithm for computing the value of a polynomial $p(x) = a_n x^n + a_{n-1} x^{n-1} + \cdots + a_1 x \cdots a_0$ at a given point x_0 and determine its worst-case efficiency class.

4. Derive the complexity of Binary Search algorithm.

5. Write down the optimization technique used for Warshall's algorithm. State the rules and assumptions which are implied behind that.

6. List out the memory functions used under Dynamic Programming.

7. What do you mean by 'perfect matching' in bipartite graphs?

8. Define flow 'cut'.

9. How NP-Hard problems are different from NP-Complete?

10. Define Hamiltonian Circuit problem.

PART B — (5 × 16 = 80 marks)

11. (a) If you have to solve the searching problem for a list of n numbers, how can you take advantage of the fact that the list is known to be sorted? Give separate answers for

(i) lists represented as arrays.

(ii) lists represented as linked lists.

Compare the time complexities involved in the analysis of both the algorithms. (16)

Or

(b) (i) Derive the worst case analysis of Merge Sort using suitable illustrations. (8)

(ii) Derive a loose bound on the following equation:

$$f(x) = 35x^8 - 22x^7 + 14x^5 - 2x^4 - 4x^2 + x - 15.$$ (8)

12. (a) (i) Solve the following using Brute-Force algorithm: (10)

Find whether the given string follows the specified pattern and return 0 or 1 accordingly.

Examples:

(1) Pattern: "abba", input: "redblueredblue' should return 1

(2) Pattern: "aaaa", input: "asdasdasdasd' should return 1

(3) Pattern: "aabb", input: "xyzabcxzyabc" should return 0

(ii) Explain the convex hull problem and the solution involved behind it. (6)

Or

(b) A pair contains two numbers, and its second number is on the right side of the first one in an array. The difference of a pair is the minus result while subtracting the second number from the first one. Implement a function which gets the maximal difference of all pairs in an array (using Divide and Conquer method). (16)

13. (a) (i) Given the mobile numeric keypad. You can only press buttons that are up, left, right or down to the first number pressed to obtain the subsequent numbers. You are not allowed to press bottom row corner buttons (i.e. * and #). Given a number N, how many key strokes will be involved to press the given number. What is the length of it? Which dynamic programming technique could be used to find solution for this? Explain each step with the help of a pseudo code and derive its time complexity. (12)

(ii) How do you construct a minimum spanning tree using Kruskal's algorithm? Explain. (4)

Or

(b) (i) Let $A = \{l/119, m/96, c/247, g/283, h/72, f/77, k/92, j/19\}$ be the letters and its frequency of distribution in a text file. Compute a suitable Huffman coding to compress the data effectively. (8)

(ii) Write an algorithm to construct the optimal binary search tree given the roots $r(i, j)$, $0 \le i \le j \le n$. Also prove that this could be performed in time $O(n)$. (8)

14. (a) (i) Maximize $p = 2x + 3y + z$ (8)

subject to $x + y + z \le 40$

$2x + y - z \ge 10$

$-y + z \ge 10$

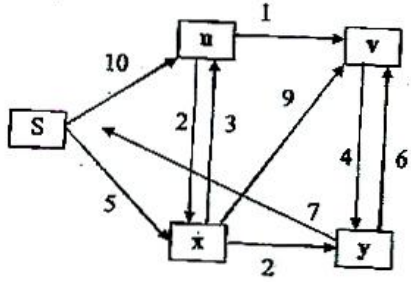
$x \ge 0, y \ge 0, z \ge 0.$

(ii) Write down the optimality condition and algorithmic implementation for finding M-augmenting paths in bipartite graphs. (8)

Or

(b) (i) Briefly describe on the Stable marriage problem. (6)

(ii) How do you compute maximum flow for the following graph using Ford-Fulkerson method? (10)



15. (a) (i) Suggest an approximation algorithm for traveling salesperson problem. Assume that the cost function satisfies the triangle inequality. (8)

(ii) Explain how job assignment problem could be solved, given n tasks and n agents where each agent has a cost to complete each task, using Branch and Bound technique. (8)

Or

(b) (i) The knight is placed on the first block of an empty board and, moving according to the rules of chess, must visit each square exactly once. Solve the above problem using backtracking procedure. (10)

(ii) Implement an algorithm for Knapsack problem using NP-Hard approach. (6)