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**J 1115**

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2006.

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Third Semester

Computer Science and Engineering

CS 231 — INTRODUCTION TO ANALYSIS OF ALGORITHMS

Time : Three hours

Maximum :100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Find the height of a heap with  $n$  nodes in it. State any intermediate results used in the proof.
2. Draw a directed graph with four vertices in it. Show the adjacency list representation for this graph.
3. Find the order of  $n^2 + 4n + 20$ .
4. For the following problems, what is a reasonable choice of a basic operation(s)?  
(a) traversing a graph (b) checking if a pattern string is present in a source string.
5. Describe one worst input for the linear search algorithm that searches a random list of elements. How many comparisons are done on that input?
6. What is an internal sort algorithm? Give two examples.
7. List the basic operations of an external sort algorithm.
8. Define the Minimal Spanning Tree (MST) of a weighted graph. Give a real-world problem where MST can be used.
9. Define a cut vertex of a graph. What is the cut vertex of the graph of question 2 (if it has one)?
10. Formulate any one 'hard' problem.

11. Write down the BINARY SEARCH algorithm that searches for an element in a sorted list and analyze it for its worst-case behavior. Derive all the intermediate results used. (16)

12. (a) Describe the tournament method to find the largest in a given list of elements. How many comparisons does the algorithm do in the worst case? Explain how it can be used to find the second largest element in the list. How many comparisons are required in the worst case to find the second largest element. (16)

Or

- (b) (i) Consider the LINEAR SEARCH algorithm that searches for an element in a sorted list and do an average case analysis of its behavior. (10)

- (ii) Find the closed form for  $Q$  given by the following recurrence relation :  $Q(n) = n - 1 + 2Q(n/2)$ ;  $Q(1) = 0$ ; Assume that  $Q$  is defined for all powers of 2. (6)

13. (a) Write the complete QUICKSORT algorithm and analyze its average-case behavior. State clearly any assumptions made. (16)

Or

- (b) (i) Write the external sort algorithm with four tapes. (6)

- (ii) Suppose that  $r$  runs constructed during the first phase of an external sort are distributed so that one run is on one tape and all the others are on another tape. How many passes over the keys will be done in the merge phase using three tapes? Derive the answer. (10)

14. (a) Given a weighted graph, give the algorithm that outputs the edges in a minimal spanning tree. Explain clearly the data structure used in its implementation. Do a worst-case analysis of it. (16)

Or

- (b) Given a weighted, directed graph, give the algorithm that outputs the edges in a shortest path between a source vertex and a destination vertex. Explain clearly the data structure used in its implementation. Do a worst-case analysis of it. (16)

- (a) Explain with examples the following classes of problems : P, NP and NP complete. (16)

Or

- (b) (i) Give the KMP scan algorithm and arrive at its worst-case analysis. (10)
- (ii) Draw the KMP pattern matching flow chart for the following pattern : AABBBAB. (6)

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