B.C.S.E. FINAL EXAMINATION, 2005

(2nd Semester)

DESIGN AND ANALYSIS OF ALGORITHMS

Time: Three Hours   Full Marks 100

Answer any five questions.

1. (a) Discuss the different ways of measuring work done by an algorithm. Which one is most commonly used and why?

(b)   What do you mean by optimality? Write the Binary Search algorithm and prove its optimality.

$$(4+2) + (2+4+8) = 20$$

2. (a) Discuss what you mean by best case, worst case and average case analysis of an algorithm.

(b)   What is the difference between average case analysis and amortized analysis? Briefly describe the three common techniques used in amortized analysis.

(c)   Find the amortized cost of incrementing a binary counter using potential method.

$$4 + (2+6) + 8 = 20$$

3. (a) What do you mean by the statement: The running time of algorithm A is $T(n) = \Theta(n^2)$? Use diagram to explain your answer.

(b)   What is the difference between O - notation and o- notation?

(c)   What is a recurrence? Solve the following recurrence relation using iteration method. $T(n) = 3T(n/4) + n$.

(d)   Give recursion tree for the recurrence relation: $T(n) = 2 T(n/2) + n2$ .Apply Master Theorem to solve the recurrence.

$$6 + 2 + (2 + 4) + (2 + 4) = 20$$

4. (a) Compare Divide and Conquer technique of algorithm design with Dynamic Programming. What are the two key ingredients that an optimization problem must have for dynamic programming to be applicable?

(b) Discuss the different submodels of PRAM.

(c) Write a PRAM-based sorting algorithm.

(d) Discuss the Bulk Synchronous Parallel Computer (BSP) model.

(e) Compare BSP with PRAM model.

$$6 + 4 + 4 + 3 + 3 = 20$$

5. (a) Give an algorithm which sorts in linear time. Explain the functioning of the algorithm with examples. How does it differ from the algorithms like Merge Sort and Heapsort?

(b)   What is a heap? What is the partial order tree property of heap?

(c)   Give an exact analysis of the cost of building a heap. comment on the running time of Heapsort.

(d)   What is a recursion tree?

$$(3 + 3 + 2) + 4 + (4 + 2) + 2 = 20$$

6. (a) Give a BSP implementation of Merge Sort algorithm.
    What is the estimated computational cost of the algorithm on a Sun SPARC server having two processors with BSP parameters as follows: $g = 3.5$, $l = 125$ (values are given in time units)? Assume that the algorithm runs on 2 processors for an input of size $n = 10$.

    (b) How does *memoization* differ from usual dynamic programming approach? Give the pseudo-code of *memoized matrix-chain algorithm*.

    (c) Discuss the worst case behaviour of Quicksort. Draw a recursion tree to explain the worst case behaviour.

$$(4 + 4) + (2 + 4) + 6 = 20$$

7. (a) Define the classes P and NP. Discuss what you mean by Polynomial Reductions.

(b) What are the different steps taken by Nondeterministic algorithms? Give a nondeterministic Graph-coloring algorithm.

(c) Prove that Hamiltonian cycle problem in NP-complete.

$$(3+3) + (2+4) + 8 = 20$$

8. (a) Write a greedy algorithm for generating Huffman code. Comment on the running time of the algorithm.

(b) Prove the correctness of Huffman's algorithm.

$$(4+2)+14 = 20$$