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B.C.A. 5th Semester End-Term Examination

DESIGN AND ANALYSIS OF ALGORITHMS

(New Regulation)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Answer the following :

(10 × 1 = 10)

- (i) The running time of an algorithm is given by
 - (a) Total number of basic operations performed by the algorithm
 - (b) Total number of statements
 - (c) Maximum time taken to execute
 - (d) None of the above
- (ii) Small Oh Notation gives
 - (a) Strict Upper Bound of a function
 - (b) Upper bound of a function
 - (c) Lower bound of a function
 - (d) None of the above
- (iii) Which of the following method is used to solve a recurrence
 - (a) Substitution method
 - (b) Recursion tree method
 - (c) Master Method
 - (d) All of the above
- (iv) Which of the following case does not exist in complexity theory?
 - (a) Best case
 - (b) Worst Case
 - (c) Average case
 - (d) Null Case

[Turn over

- (v) If $f(n) = \theta(g(n))$ then
- $0 \leq c_1g(n) \leq f(n) \leq c_2g(n)$ for all $n \geq n_0$
 - $0 \leq c_1g(n) \leq f(n)$ for all $n \geq n_0$
 - $0 \leq f(n) \leq c_2g(n)$ for all $n \geq n_0$
 - None of the above
- (vi) Which of the following sorting algorithm adopts divide and conquer strategy?
- Insertion Sort
 - Bubble sort
 - Merge sort
 - Selection sort
- (vii) Two main measures for the efficiency of an algorithm are
- Processor and memory
 - Complexity and capacity
 - Time and space
 - Data and space
- (viii) In linear search average case occurs
- When Item is somewhere in the middle of the array
 - When Item is not in the array at all
 - When Item is the last element in the array
 - When Item is the last element in the array or is not there at all
- (ix) Which of the following statement is true for a Divide and conquer algorithm
- The sub problems are solved only once
 - The sub problems are solved non recursively
 - The sub problems are solved only once recursively
 - The sub problems are solved repeatedly and recursively
- (x) The running time of quick sort depends on the
- No of input
 - Arrangement of element
 - Partitioning element
 - None of the above
2. (a) What is instance of a problem? What will be instance of the problem to check whether a number is prime or not? (2+2=4)
- (b) What is time complexity of an algorithm? Explain best case, average case and worst case time complexity of an algorithm. (2+6=8)
- (c) Is $2^{n+1} = O(2^n)$? (3)

3. (a) Show that for any two function $f(n)$ and $g(n)$
 $f(n) = \theta(g(n))$ if and only if $g(n) = \theta(f(n))$ (5)
- (b) Rank the following functions by order of growth (5)
 $2n, n, n \lg n, n^2$
- (c) What is a recurrence? What are the different methods of solving a recurrence? (5)
4. (a) What is a divide and conquer algorithm. What are the different steps followed in a divide and conquer algorithm. Give the general recurrence of a divide and conquer algorithm. (5)
- (b) Analyse the running time of Merge sort using recursion tree method? (10)
5. (a) Apply Insertion sort on the following set of elements. (10)
 55, 88, 22, 99, 44, 11, 66, 77, 33
- (b) Define P, NP and NP complete problems. (5)
6. (a) Solve the following recurrences using Master Theorem (4 × 2.5 = 10)
- (i) $T(n) = 4T(n/2) + n$
- (ii) $T(n) = 4T(n/2) + n^2$
- (iii) $T(n) = 4T(n/2) + n^3$
- (iv) $T(n) = 4T(n/2) + n^2\sqrt{n}$
- (b) Differentiate between big oh and small oh notation. (5)
7. (a) Construct the Huffman code of the characters in a data file of 100000 characters for the following set of frequencies(in thousands) (10)
 a:45 b:13 c:12 d:16 e:9 f:5
- (b) What is coin changing problem? Explain how greedy algorithm can be used to solve this problem. (5)