Nirma University

Institute of Technology

Semester End Examination (RPR), December - 2016

B. Tech. in Computer Engineering / Information Technology, Semester-VI

CE601 Design and Analysis of Algorithms

Roll / Exam No. | Supervisor's Initial with Date

Time: 3 Hours | Max Marks: 100

Instructions:
1. Attempt all the questions.
2. Figures to right indicate full marks.
3. Draw neat sketches wherever necessary.

Section I

Q-1 Do as directed **[18]**

a) Design an optimal algorithm to perform sorting of an array consisting of n elements using insertion sort. Analyse time complexity of the algorithm by showing step by step calculations for each step of the algorithm. [10]

b) Write an algorithm that accepts two sorted subarrays and merge them to produce a sorted array. Also prove the correctness of your algorithm. [8]

Q-2 Do as directed **[16]**

a) State and prove "Limit Rule" for given two arbitrary functions f and $g : N \rightarrow R^+ \cup \{0\}$. Also apply the same to the following two functions $f(n) = \log n$ and $g(n) = \sqrt{n}$ [6]

OR

a) Which property of real numbers does not carry over to asymptotic notations? Explain with a suitable example. [6]

b) Apply heap sort procedure on the following elements:- 15, 19, 10, 7, 17, 16. Show all necessary steps. [6]

c) In which situations will the Quick sort algorithm result into the "worst case" performance? What will be the running time of the algorithm in those scenarios? [4]

Q-3 Do as directed **[16]**

a) Write a pseudo code for "Linear Search", which scans through the sequence of n numbers $A = \langle a_1, a_2, a_3, \ldots, a_n \rangle$, looking for v. Using a loop invariant, prove that your algorithm is correct. Make sure that your loop invariant fulfills the three necessary properties. [6]

OR

a) Derive the expression indicating the running time of an algorithm in which the pivot element is selected as the "Median of medians". [6]

b) Determine the time complexity of the following function :- [6]

```
int f(int n)
{
if (n == 1)
return 1;
else
return (f(n-1) +n );
}
```

c) What do you mean by "Amortized analysis" of an algorithm? Take a suitable example and demonstrate its amortized analysis. [4]

Section II

Q-4 Do as directed **[16]**

a) Solve the following recurrence by Recurrence Tree method. [4]
$T(n) = 3T(n/4) + n^2$

b) Solve the following recurrence relation using "Change of variable" method:- [4]
$T(n) = 2T(\sqrt{n}) + \log n$

c) Answer whether the following statement is True or False:- [4]
"Greedy Approach always gives an optimal solution." Justify with an example.

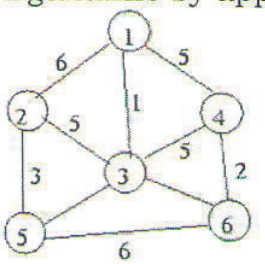
d) Binomial heap is more preferable as compared to Binary heap. Justify with a suitable example. [4]

OR

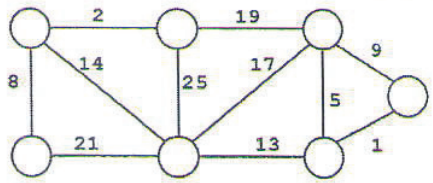
d) Consider two algorithms A and B that take time in $\theta(n^2)$ and $\theta(n^3)$ respectively to solve the same problem. If other resources such as storage and programming time are of no concern, is it necessarily the case that algorithm A is always preferred over algorithm B? Justify your answer. [4]

Q-5 Do as directed **[16]**

a) For the following graph, find minimum spanning tree using Prim's algorithms by applying Greedy Approach. [8]



b) For the following graph, find minimum spanning tree using Kruskal's algorithm by applying Greedy Approach. [8]



OR

b) Solve the following knapsack problem using greedy approach :- [8]

W=10, weights are {1,5,3,4,2 } and values are {15,10, 9, 5, 3}.

Q-6 Do as directed **[18]**

a) Given two strings, X = abccb and Y = bdcabc. Find the Longest Common Subsequence of X and Y using dynamic programming. [6]

b) Find the optimal order and cost for multiplying the matrices using dynamic programming. (A × B × C × D × E). The dimensions of the matrices are as given below:- [6]

A:-(10×4), B:-(4 × 5), C:-(5 × 20), D:-(20 × 2) and E:-(2 × 50)

c) For the following diagram, solve the single source shortest problem using Dijkstra's Algorithm. Starting node is A. [6]