मोतीलाल नेहरू राष्ट्रीय प्रौद्योगिकी संस्थान इलाहाबाद
प्रयागराज-211004 (भारत)
Motilal Nehru National Institute of Technology Allahabad
Prayagraj-211004 [India]

Computer Science & Engineering Department
Mid Semester Examination 2023-24 (EVEN)

Programme Name: B.Tech. (CSE Minor) **Semester:** 4th

Course Code: CS14XXX **Course Name:** Analysis of Algorithms

Branch: ALL **Student Reg. No** 2 0 2 2 2 0 6 8

Duration: 90 Minutes **Max. Marks:** 25

Instructions:

1. *This question paper comprises 5 (five) compulsory questions.*
2. *Try to answer the questions serially.*
3. *It is advisable to design a solution in rough before writing the final algorithm.*
4. *All the algorithms should be written in steps with proper indentation on conditions and loops.*

Q1 Design an algorithm for the implementation of Recursive Bubble Sort. Iterative Bubble Sort algorithm is provided below for your reference: **Marks (5)**

```
BubbleSort(arr[], n) {
    for (i = 0; i < n-1; i++)
    // Last i elements are already in place
        for (j = 0; j < n-i-1; j++) {
            if(arr[j] > arr[j+1])
            swap(arr[j], arr[j+1]);
        }
}
```

Q2 Explain Master's Theorem and solve the following recurrences **(1+2x2)**

a $T(n) = 2\,T(n^{1/2}) + \lg n$.

b $T(n) = 4T(\sqrt[3]{n}) + n$

Q3 Analyze the worst-case complexities of the following algorithms: **(2.5x2)**

a *Heapfy*

b *Build Heap*

Q4 Along with its complexity analysis, write an algorithm to merge k sorted lists, each of length n. **(5)**

Q5 Along with its complexity analysis, write an algorithm to find i^{th} order static. **(5)**

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Computer Science & Engineering Department
End Semester Examination 2023-24 (Even)

Programme Name: B.Tech. (CSE Minor) 35+ Semester: 4th

Course Code: CSN14003 Course Name: Analysis of Algorithms

Branch: ALL Student Reg. No | 2 | 0 | 2 | 2 | 2 | 0 | 6 | 8 | |

Duration: 150 Minutes Max. Marks: 50

Instructions:

1. *This question paper comprises 5 (five) compulsory questions.*
2. ***It is advisable to design a solution in rough before writing the final algorithm.***
3. ***All the algorithms should be written in steps with proper indentation on conditions and loops.***
4. *Try to answer the questions serially.*

			Marks	Course Outcome Mapping
Q1	a	Given the time complexity as *f(n) μ secs* of various algorithms in the table in the right, find the data size than can be solved in 1 second and 1 minute.	5	CO1, CO2

f(n) μ secs	1 second	1 minute
$lg\ n$		
$\sqrt{n}$		
n		
$n\ lg\ n$		
2^n		

	b	Describe an algorithm that, given n integers in the range p to q, preprocesses its input and then answers any query about how many of the n integers fall into a range [a..b]. Provided: $n >> q - p$ and $p < a < b < q$.	5	CO1
Q2		In context of Dynamic Programming, answer the following questions:		CO3
	a	Write an algorithm to find and print All Pair Shortest Path.	4	
	b	Modify the algorithm in (a) to find the Total Number of Paths between any two nodes of graph. *(Total Number of Paths between any two nodes (say, x and y) of graph is the number of different ways we can traverse from x to y.)*	3	
	c	Modify the algorithm in (a) to find Transitive Closures in any graph. *(In Transitive Closure we have to simply determine whether or not there is a path from node x to node y in one or more hops. Unlike the shortest path problem, we aren't concerned on "how long it takes to get there", rather we are interested in "whether or not if we can eventually get there".)*	3	
Q3	a	Construct a Huffman tree for the data symbols: {A, B, C, D, E} with frequency {0.17, 0.11, 0.24, 0.33 and 0.15} respectively. Find the prefix fee codes for {A, B, C, D, E} and Encode ABBACAB.	5	CO4
	b	Write backtracking strategy based algorithm for solving *n-queens* problem	5	CO5
Q4		In the context of sorting algorithms answer the following questions:		
	a	Write Shell Sort algorithm for sorting the numbers in descending order and trace the execution of your algorithm on a sequence of integer numbers: [1..10].	5	CO1
	b	Analyse the best case and worst case time complexity of Shell Sort with the help of different values of *gap* variable.	5	CO5
Q5		Write algorithms/notes on the following:		CO4
	a	Representation of graphs using adjacency list.	2	
	b	Finding cycles in the graph using DFS algorithms.	2	
	c	Minimum Spanning Trees.	2	
	d	Topological Sorting.	2	
	e	*printpath* algorithm and the labeling of π and d on the nodes.	2	