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School of Computer Science and Engineering
B.Tech (Hons.)
Midterm Question Paper SET-2
Academic Year 2024-2025

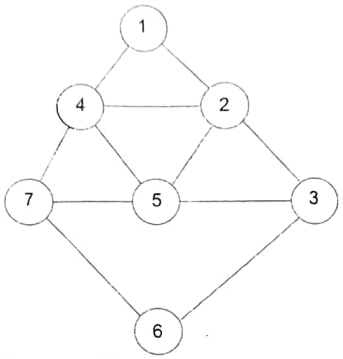
Course: Design and Analysis of Algorithms		Course Code: CS2000	Semester: III
Time: 10 AM to 11:30 AM	Duration: 90 minutes	Date: 08-10-2024	Max Marks: 25

Notes/ Instructions:

a) Answer all questions

b) Possession/ usage of Mobile Phones, Smart Watches or any other internet enabled devices during the examination will be treated as malpractice.

Sl. No.	PART A – (MCQs) Max Marks(5)	Marks	L1-L6	CO
1.	Which of the following sorting algorithm's time complexity is the most inefficient in the best-case? A. Merge sort B. Insertion Sort C. Quicksort D. Selection sort	1	L4	CO 3
2.	Suppose there are 8 sorted arrays of (n/8) elements each. If we merge these arrays into a single sorted array of n elements using two-way merge (merge two sub-arrays recursively), then how many key comparisons are needed in the worst-case using the merge algorithm? A. (6/4)n-4 B. (7/4)n-4 C. (8/4)n-4 D. (9/4)n-4	1	L4	CO 3
3.	Let H be a binary max-heap consisting of n elements implemented as an array. What is the worst-case time complexity of an optimal algorithm to find the minimum element in H? A. Θ(1) B. Θ(log n) C. Θ(n) D. Θ(n log n)	1	L5	CO 3
	Let P be a quicksort program to sort numbers in ascending order. t1 and t2 be the number of comparisons made by P for the inputs [4 3 2 1] [1 2 3 4 5] respectively. Which one of the following holds? A. t1=5 B. t1<t2 C. t1>t2 D. t1=t2	1	L4	CO 2
5.	Consider the following array of elements: <1, 3, 4, 5, 6, 7, 8, 9, 10, 2, 11, 12>. The minimum number of interchanges needed to convert it into a min-heap is	1	L5	CO 2

Sl. No.	PART B – Max Marks (20)	Marks	L1-L6	CO
6.	Apply BFS to the given graph with vertices {1, 2, 3, 4, 5, 6, 7}. Starting from vertex '1', i) List all possible orders of vertices visited using the BFS algorithm. ii) Mention the total number of orders possible.  	4+1	L5	CO 3
7.	Apply Heapsort to sort the following array in ascending order. Track the number of swaps at each iteration (step) and provide the final sorted array. [91, 99, 19, 21, 24, 86, 64, 32]. Note: Explicitly mention the number of swaps performed in each iteration.	5	L4	CO 2
8.	Apply QuickSort to sort the following array in ascending order. Track the number of swaps at each iteration (step) and provide the final sorted array. [21, 19, 15, 7, 1, 5, 3, 12] Note: Mention clearly which index is being used as a pivot (first or last). Additionally, indicate the number of swaps carried out during each iteration.	5	L4	CO 2
9.	**a.** The number of possible max heaps containing each value from {1, 2, 3, 4, 5} exactly once is _____. You are required to draw all possible max-heaps. **b.** A complete binary min-heap is made by including each integer in [1, 1023] exactly once. The depth of a node in the heap is the length of the path from the root to that node. Thus, the root is at depth 0. The maximum depth at which integer 9 can appear is _____. Draw the min-heap to justify your answer.	3+2	L4	CO 2

Course Outcomes

1. Design algorithms for addressing sub problems and tasks involving an algorithm component using appropriate design techniques (brute force, greedy, dynamic programming, etc.) as relevant, these tasks could arise in the context of various applications such as engineering, Operations Research, e-commerce and so on
2. Implement a variety of standard algorithms typically covered in an undergraduate course on Design and Analysis of Algorithms such as well known sorting and searching algorithms, graph related algorithms etc., in a high level language
3. Analyze algorithms and be able to characterize the performance of different algorithms using asymptotic notation.
4. Apply and implement learned algorithm design techniques and data structures to solve real world problems

Marks Distribution									
L1	L2	L3	L4	L5	L6	CO1	CO2	CO3	CO4
			18	7			17	8	