

**B.E. INFORMATION TECHNOLOGY THIRD YEAR SECOND SEMESTER EXAM
2024**

DESIGN & ANALYSIS OF ALGORITHMS

Time: Three Hours

Full Marks: 100

CO1 (20): a. Given a min heap of n elements. Write an efficient algorithm to find the 4th minimum element from the heap. Prove your algorithm. Compute time and space complexity.

(5+4+3+2)

OR

Write an efficient algorithm to find the 2nd largest element from a min heap. Prove your algorithm. Compute time and space complexity.

(5+4+3+2)

b. Compute time complexity of the given recurrence relations.

(2+2+2)

- I. $T(n)=2T(n/2)+\sqrt{n}$
- II. $T(n)=3T(n/2)+n$
- III. $T(n)=\sqrt{2}T(n/2)+\log n$

CO2 (10): a. What is the output and running time of the following functions (specified as a function of the input value) explain your algorithm.

(2+2)

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|--------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>A.void Function(int n)</p> <pre> { int i=1 ; int s=1 ; while(s < n) { i++; s= s+i ; print("*"); } } </pre> | <p>B.void function(int n)</p> <pre> { int i, j, k , count =0; for(i=n/2; i<=n; i++) for(j=1; j + n/2<=n; j= j++) for(k=1; k<=n; k= k * 2) count++; } </pre> |
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b. "The greedy approach always gives an optimal solution" –

the statement is true or false? Justify your answer with example.

(2)

[Turn over

- c. What is advantage of dynamic programming over divide and conquer approach? (2)
- d. Differentiate between backtracking and branch & bound algorithm strategy. (2)

CO3 (30):

- a. Given two 50 digits binary numbers. Write an efficient algorithm to multiply these two numbers. Compute time complexity. (8+2)
OR
Given an integer a and a positive integer n , describe a method to compute a^n using only multiplications. How many multiplications does your algorithm use? How many does it used to compute a^{100} ? (10)
- b. What is the string edit distance between two strings X and Y . Compute the string edit distance between the string $X = \text{"JADAVPUR"}$ and $Y = \text{"JALPAIGURI"}$ using dynamic programming technique. (2+8)
OR
Write an efficient algorithm to finds the maximum difference between any two elements of a given array of n numbers (not necessarily distinct) in $O(n)$ time. (10)
- c. Let the frequency of the letters i,n,d,e,x, 16,7,17,25,20 respectively. What will be the Huffman's code for the letter x. Explain the algorithm and its complexity. (3+5+2)
OR
Give the solutions of 4-queen problem. Solve following fractional Knapsack problem using greedy approach where $m=16$, $n=6$, $P=(2, 6, 8, 1, 3, 5)$, $W=(10, 6, 5, 3, 1, 3)$ (3+7)

CO4 (20): a. Illustrate the operation of algorithm insertion sort on the array

{45, 33, 24, 45, 12, 12, 24, 12}

How many comparisons are performed by the algorithm? (6)

b. Let $A[1..60] = 11, 12, \dots, 70$. How many comparisons are performed by algorithm binary search when searching for the following values of x ?

(a) 33. (b) 78. (2+2)

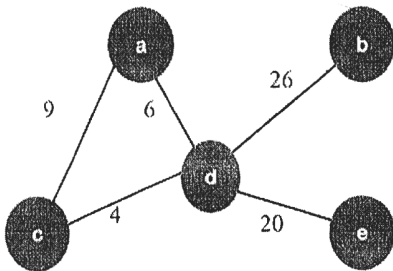
c. Given a list of n numbers, give an efficient algorithm to determine whether they are all distinct. Compute the complexity of your algorithm. (7+3)

CO5 (10): a. How do you determine whether a graph is connected? What is the complexity of your algorithm? (5)

OR

How do you determine whether a given graph has a cycle in $O(n)$ time (regardless of the number of edges in the graph)? (5)

b. Find out the MST of the given graph (5)



CO6 (10): a. Explain P, NP, NP complete and NP hard. (5)

b. Prove that 0/1 Knapsack problem is NP complete. (5)