Ref. No. : Ex/IT/PC/B/T/321/2023

# B.E. INFORMATION TECHNOLOGY THIRD YEAR SECOND SEMESTER EXAM 2023

## DESIGN & ANALYSIS OF ALGORITHMS

**Time: Three Hours** **Full Marks: 100**

*Different parts of the same question should be answered together*

### CO1(15 Marks)

Answer any ***one*** question (A or B)

A. (a) Let A[1..60] = 11, 12, . . . , 70. How many comparisons are performed by Algorithm binary search when searching for the following values of x? 11,35,70,80 (6)

(b) Explain the tight bound of an algorithm? Compute time complexity of the given recurrence relations. (9)

(i) $T(n)=2T(n/2)+\sqrt{n}$

(ii) $T(n)=3T(n/2)+ n$

(iii)$T(n)=\sqrt{2}T(n/2)+ \log n$

B. (a) When do we need tree and graph data structure to store data? Explain both with example. Define big o (O) and theta (θ) notation with graphical representation. (3+3 +3+3 )

(b) Which of the following arrays are heaps? Justify your answer. (3)

(a) 8, 6, 4, 3, 2 .

(b) 7 .

(c) 9 7 5 6 3 .

(d) 9 4 8 3 2 5 7 .

(e) 9 4 7 2 1 6 5 3 .

### CO2 (15 Marks)

Answer any ***one*** question

(a) (i)"The greedy approach always gives an optimal solution" the statement is true or false? Justify your answer with example. (ii) Explain the basic difference between Divide and conquer Approach and Dynamic Programming Approach. (iii) Explain the basic difference between Backtracking and Branch and Bound. (5+5+5)

(b) Show that Knapsack problem can be solved using (1) Greedy method, (2) Dynamic programming and (3) Branch and Bound. (5+5+5)

**CO3 (30 Marks)**

Answer ***any*** three questions

(a) 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 use to compute $a^{100}$? (7+2+1=10)

(b) Given two sets A and B of n elements each from a totally ordered set, give an efficient algorithm to report all the elements that are common to both A and B. If the integers in A are in the range 1 to 100, can you design a better algorithm? (7+3 = 10)

(c) Use Algorithm LCS to find the length of a longest common subsequence of the two strings A = "xzyzzyx" and B = "zxyyzxz". Give one longest common subsequence. (10)

(d) Give an efficient algorithm for 4-queen problem. Compute the complexity of your algorithm. 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=10)

**CO4 (20 Marks)**

Answer ***any*** two questions

(a) Given a list of 100 numbers, give an efficient algorithm to determine whether they are all distinct. Analyse your algorithm. (10)

(b)Give an efficient algorithm to find the second largest element from a list of 50 numbers. Report the number of comparisons. (10)

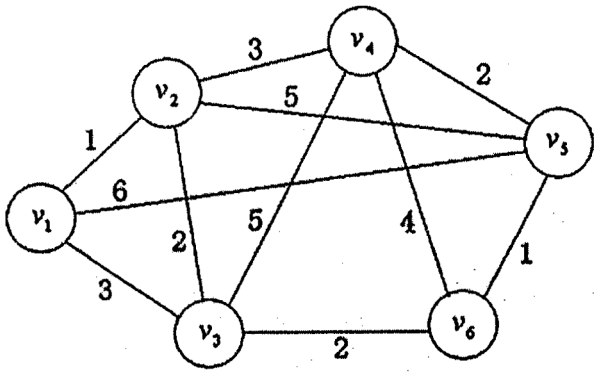
(c)Give an algorithm to find the smallest and the largest element from a list of n numbers. How many comparisons does your algorithm use? (10)

**CO5 (10 Marks)**

Answer ***any*** one question

(a) How you can detect a cycle in a graph using Disjoint Set concept? (3)
Give an example of a directed graph to show that Algorithm Dijkstra does not always work if some of the edges have negative weights. Propose a method to resolve the issue. (4+3)

(b)Compute the Minimum Spanning tree (MST) of the given graph using Kruskal's algorithm. Derive the time complexity of Kruskal's algorithm. (10)




**CO6 (10)**

Answer ***any*** two questions

X

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

(b) Prove that Clique finding problem is a NP-Complete problem. (5)

(c) Prove that 3-SAT problem is a NP-Complete problem. (5)