

III B. Tech II Semester Regular/Supplementary Examinations, April -2018
DESIGN AND ANALYSIS OF ALGORITHMS

(Common to Computer Science Engineering and Information Technology)

Time: 3 hours

Max. Marks: 70

- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
 2. Answering the question in **Part-A** is compulsory
 3. Answer any **THREE** Questions from **Part-B**

PART -A

- 1
 - a) Devise an algorithm that sorts a collection of $n \geq 1$ elements of arbitrary type. [3M]
 - b) State the best, average and worst case complexities of binary search for successful and unsuccessful search. [4M]
 - c) Write the functional difference of divide and conquer greedy method. [4M]
 - d) State the principle of optimality. Find two problems for which the principle does not hold. [4M]
 - e) Define Implicit constraints and Explicit constraints with example. [3M]
 - f) What is branch and bound algorithm? How it is different from backtracking? [4M]

PART -B

- 2
 - a) Prove the theorem if $f(n) = a_m n^m + \dots + a_1 n + a_0$, then $f(n) = O(n^m)$. [4M]
 - b) Describe the Pseudo code conventions for specifying algorithms of recursive and an iterative algorithm to compute $n!$ [8M]
 - c) Determine the frequency counts for all statements in the following algorithm segment. [4M]


```

i:=1;
while(i≤n) do
{
  x:=x+1;
  i:=i+1;
}
```
- 3
 - a) Solve the recurrence relation using substitution method [3M]

$$T(n) = \begin{cases} T(1) & n=1 \\ aT(n/b) + f(n) & n>1 \end{cases}, \text{ where } a=5, b=4, \text{ and } f(n) = cn^2.$$
 - b) Apply quick sort algorithm to sort the list. E, X, A, M, P, L, E in alphabetical order. [8M]
 - c) Analyze the best, average and worst case complexity of quick sort. [5M]
- 4
 - a) Compare BFS and DFS algorithm with an example graph and denote its time complexities. [8M]
 - b) Derive time complexity of job sequencing with deadlines .Obtain the optimal solution when $n=5$, $(p_1, p_2, \dots) = (20, 15, 10, 5, 1)$ and $(d_1, d_2, \dots) = (2, 2, 1, 3, 3)$. [8M]

- 5 a) Describe about reliability design with an example. [8M]
 b) Obtain the solution to knapsack problem by Dynamic Programming method $n=6$, [8M]
 $(p_1, p_2, \dots, p_6) = (w_1, w_2, \dots, w_6) = (100, 50, 20, 10, 7, 3)$ and $m=165$.
- 6 a) Explain how backtracking is used for solving n - queens problem. Show the state [8M]
 space tree.
 b) Describe the algorithm for Hamiltonian cycles and Determine the order of [8M]
 magnitude of the worst-case computing time for the backtracking procedure that
 finds all Hamiltonian cycles.
- 7 a) Explain the principles of FIFO Branch- and-Bound. [8M]
 b) Consider the travelling salesperson instance defined by the cost matrix. [8M]
 Obtain the reduced cost matrix and the portion of the state space tree that will be
 generated by LCBB.

∞	7	3	12	8
3	∞	6	14	9
5	8	∞	6	18
9	3	5	∞	11
18	14	9	8	∞

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PART -A

- 1
 - a) What are the four distinct areas of study of algorithm? [4M]
 - b) Is quick sort a stable sorting method? Justify. [3M]
 - c) What is meant by '*ordering paradigm*'? Give an example problem. How it is different with '*subset paradigm*' of the greedy technique. [4M]
 - d) What is *purging* or *dominance rule*. How it is applicable. [3M]
 - e) Define *state space* and *state space tree*. [4M]
 - f) Describe about Bounding with suitable example. [4M]

PART -B

- 2
 - a) Prove the theorem if $f(n)=a_m n^m + \dots + a_1 n + a_0$ and $a_m > 0$, then $f(n)=\Theta(n^m)$. [4M]
 - b) Write a recursive algorithm to find the sum of first n integers and Derive its time complexity. [8M]
 - c) Mention the important advantages and disadvantages of using randomized algorithms. [4M]
- 3
 - a) Can we say that the time for **Merge Sort** is $\Theta(n \log n)$. What is its worst and best time of procedure for **Merge Sort**. [3M]
 - b) Write recursive binary search algorithm with an example and analyze time complexity. List the applications of binary search. [8M]
 - c) Describe the control abstraction for divide and conquer. [5M]
- 4
 - a) Use an algorithm for greedy strategies for the knapsack to find an optimal solution to the knapsack instance $n=7, m=15, (p_1, p_2, \dots, p_7)=(10, 5, 15, 7, 6, 18, 3)$, and $(w_1, w_2, \dots, w_7)=(2, 3, 5, 7, 1, 4, 1)$. [8M]
 - b) Apply greedy algorithm to generate single-source shortest path with an example graph. Mention its time complexity. [8M]
- 5
 - a) Write about Dynamic Programming General method. [6M]
 - b) Describe the algorithm to find minimum-cost binary search tree. Show that the computing time of function OBST is $O(n^2)$. [10M]
- 6
 - a) Mention an algorithm that Presents a recursive formulation of the backtracking technique. [8M]
 - b) Find all possible subsets of w that sum to m . Let $w=\{5, 7, 10, 12, 15, 18, 20\}$ and $m=35$ and draw the portion of the state space tree that is generated. [8M]
- 7
 - a) Draw the portion of the state space tree generated by LCBB for the knapsack instance: $n=5, (p_1, p_2, p_3, p_4, p_5)=(10, 15, 6, 8, 4)$, $(w_1, w_2, w_3, w_4, w_5)=(4, 6, 3, 4, 2)$, and $m=12$. [8M]
 - b) Apply branch and bound algorithm to solve the travelling salesman problem with an example. [8M]

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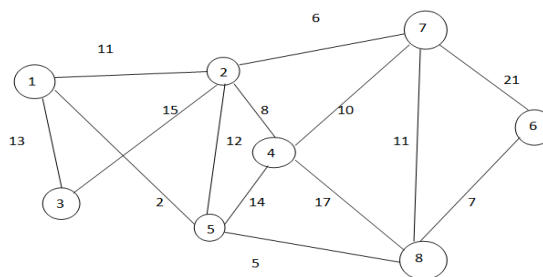
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PART -A

- 1 a) List out the criteria's of an algorithm. [4M]
- b) Mention the advantages and disadvantages of binary search. [3M]
- c) Represent a high-level description of job sequencing algorithm. [4M]
- d) List the features of dynamic programming. [3M]
- e) Define chromatic number of a graph and planar graph. [4M]
- f) What is branch and bound algorithm? How it is different from backtracking? [4M]

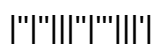
PART -B

- 2 a) Show that the following equalities are incorrect with suitable notations [4M]
i) $10n^2+9=O(n)$ ii) $n^2 \log n = \Theta(n^2)$
- b) Implement an algorithm to generate Fibonacci number sequence and determine the time complexity of the algorithm using the frequency method. [8M]
- c) Write about three popular methods to arrive at amortized costs for operations with example. [4M]
- 3 a) What is stable sorting method? Is merge sort a stable sorting method? Justify. [3M]
- b) Sort the list of the elements 10,5,7,6,1,4,8,3,2,9 using merge sort algorithm and show its computing time is $O(n \log n)$. [8M]
- c) Define internal and external nodes of binary decision tree. Draw the binary decision tree for binary search with $n=14$. [5M]
- 4 a) Describe the greedy method control abstraction for the subset paradigm. [8M]
- b) Define spanning tree. Compute a minimum cost spanning tree for the graph of figure using prim's algorithm. [8M]



- 5 a) Describe the Travelling sales person problem and discuss how to solve it using dynamic programming. [8M]
- b) Design a three stage system with device types D_1 , D_2 , D_3 . The costs are \$30, \$15, \$20 respectively. The cost of the system is to be no more than \$105. the reliability of each device type is 0.9, 0.8 and 0.5 respectively. [8M]

- 6 a) Describe general iterative backtracking algorithm. [8M]
b) Write a backtracking algorithm to solve sum of subsets problem with $m=35$, [8M]
 $w = \{20, 18, 15, 12, 10, 7, 5\}$ to the variable tuple size formulation.
- 7 a) Describe about Control Abstractions for LC-search. [8M]
b) Draw the portion of the state space tree generated by LCBB for the knapsack instance: [8M]
 $n=5, (p_1, p_2, p_3, p_4, p_5) = (w_1, w_2, w_3, w_4, w_5) = (4, 4, 5, 8, 9)$, and $m=15$.



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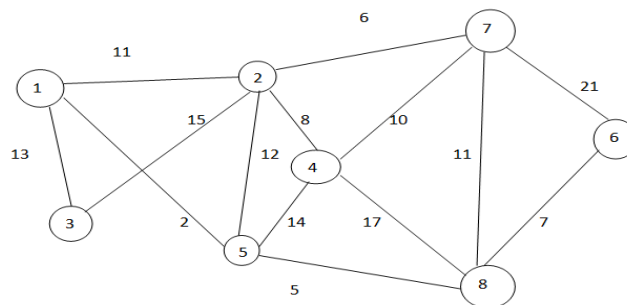
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PART -A

- 1 a) Define Little Oh notation with example. [3M]
- b) Describe the time complexity of Divide And Conquer in the recurrence form. [4M]
- c) What is knapsack problem? State knapsack problem formally. [4M]
- d) Distinguish Greedy method and Dynamic Programming. [3M]
- e) Denote live node and dead node with example. [4M]
- f) Compare LC and FIFO brand- and-bound. [4M]

PART -B

- 2 a) Write a recursive algorithm to solve Towers of Hanoi problem with an example. [4M]
- b) Describe about probabilistic analysis in detail. [8M]
- c) Implement iterative function for sum of array elements and find the time complexity use the increment count method. [4M]
- 3 a) Why is it necessary to have the auxiliary array $b[low: high]$ in function *Merge*? [3M]
- b) Apply **Merge Sort** to sort the list $a[1:10]=(31,28,17,65,35,42,86,25,45,52)$. Draw the tree of recursive calls of merge sort, merge functions. [8M]
- c) Write iterative binary search algorithm with example. [5M]
- 4 a) Use the greedy algorithm for sequencing unit time jobs with deadlines and profits to generate the solution when $n=7, (p_1, p_2, \dots, p_7)=(3, 5, 20, 18, 1, 6, 30)$, and $(d_1, d_2, \dots, d_7)=(1, 3, 4, 3, 2, 1, 2)$. [8M]
- b) Define spanning tree. Compute a minimum cost spanning tree for the graph of figure using kruskal's algorithm. [8M]



- 5 a) Describe All-pairs shortest path algorithm with example. Give the time complexity of the algorithm. [8M]
- b) Consider $A_1=5 \times 4$, $A_2=4 \times 6$, $A_3=6 \times 2$, $A_4=2 \times 7$. $P_1=5$, $P_2=4$, $P_3=6$, $P_4=2$, $P_5=7$ and Apply matrix chain multiplication to obtain optimal sequence. [8M]

- 6 a) Describe an algorithm to solve 8-queen problem and Show the state space tree. [8M]
b) Write an algorithm for finding all m -coloring of a graph with example. [8M]
- 7 a) What is branch & bound? Explain the role of bounding function in it using LC - search [8M]
b) Generate FIFO branch and bound solution for the given knapsack problem. $m = 15$, [8M]
 $n = 3$.
 $(P_1 \ P_2 \ P_3) = (10, 6, 8)$ $(w_1 \ w_2 \ w_3) = (10, 12, 3)$
