Code No: RT32054 **R13** SET - 1

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**

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PART –A

1	a)	Devise an algorithm that sorts a collection of n≥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 $f(n)=a_m n^m+\ldots\ldots+a_1 n+a_0$,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 $T(n)=\begin{cases} T(1) & n=1 \\ aT(n/b)+f(n) & n>1 \end{cases}$,where a=5,b=4,and $f(n)=cn^2$.	[3M]
	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, (p1, p2,...)=(20,15,10,5,1)* and *(d1,d2,...)=(2,2,1,3,3).*	[8M]

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5 a) Describe about reliability design with an example. [8M]
b) Obtain the solution to knapsack problem by Dynamic Programming method n=6, (p1, p2,…p6)=(w1,w2,…w6)=(100,50,20,10,7,3) and m=165. [8M]

6 a) Explain how backtracking is used for solving n- queens problem. Show the state space tree. [8M]
b) Describe the algorithm for Hamiltonian cycles and Determine the order of magnitude of the worst-case computing time for the backtracking procedure that finds all Hamiltonian cycles. [8M]

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.

$$\begin{bmatrix} \infty & 7 & 3 & 12 & 8 \\ 3 & \infty & 6 & 14 & 9 \\ 5 & 8 & \infty & 6 & 18 \\ 9 & 3 & 5 & \infty & 11 \\ 18 & 14 & 9 & 8 & \infty \end{bmatrix}$$

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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 $f(n)=a_m n^m+\ldots\ldots+a_1n+a_0$ 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 $n=7,m=15,(p1,p2\ldots.,p7)=(10,5,15,7,6,18,3)$,and $(w1,w2,\ldots w7)=(2,3,5,7,1,4,1)$.	[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,(p1,p2,p3,p4,p5)=(10,15,6,8,4),(w1,w2,w3,w4,w5)=(4,6,3,4,2), and m=12.	[8M]
	b)	Apply branch and bound algorithm to solve the travelling salesman problem with	[8M]

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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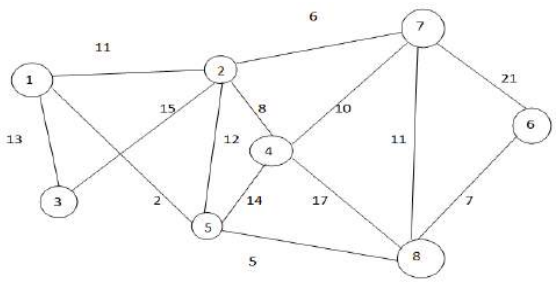
PART –A

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 i)$10n^2+9=O(n)$ ii) $n^2\log n=\Theta(n^2)$	[4M]
	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	[8M]

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6	a)	Describe general iterative backtracking algorithm.	[8M]
	b)	Write a backtracking algorithm to solve sum of subsets problem with m=35, w= {20, 18, 15, 12, 10, 7, 5} to the variable tuple size formulation.	[8M]
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: *n*=5,*(p1,p2,p3,p4,p5)=(w1,w2,w3,w4,w5)*=(4,4,5,8,9), and *m*=15.	[8M]

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

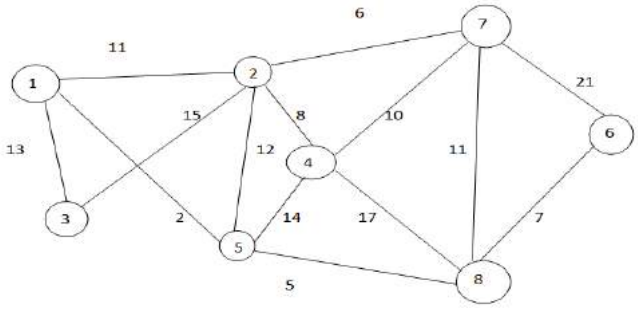
*****

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,(p1,p2,...p7)=(3,5,20,18,1,6,30),*and *(d1,d2,...,d7)=(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=5X4, A_2=4X6, A_3=6X2, A_4=2X7.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]

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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, n = 3. [8M]
$(P_1\ P_2\ P_3) = (10, 6, 8)$ $(w_1\ w_2\ w_3) = (10, 12, 3)$

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