CS43

NEW SCHEME

USN

Fourth Semester B.E. Degree Examination, July/August 2004

Computer Science /Information Science and Engineering

Analysis & Design of Algorithms

[Max.Marks : 100

Time: 3 hrs.]

Note: *Answer any FIVE full questions.*

1. (a) Define O, Θ, Ω notations. (6 Marks)

   (b) Prove : $3n^3 + 2n^2 = O(n^2); 3^n \neq O(2^n)$ (6 Marks)

   (c) If $T_1(n) = O(f(n))$ and $T_2(n) = O(g(n))$, then show that $T_1(n) + T_2(n) = O(max(f(n), g(n)))$. (8 Marks)

2. (a) Write the bubble sort algorithm and show that the worst case efficiency is quadratic. (10 Marks)

   (b) Outline an exhaustive search algorithm for travelling salesman problem. What is the efficiency class of this algorithm? Illustrate with an example. (10 Marks)

3. (a) Describe a binary search algorithm. Show that the worst case efficiency is in $\Theta(log\ n)$. (11 Marks)

   (b) Write algorithms for preorder, postorder, and inorder traversals of a tree. List the tree of Fig 3(b) in preorder, postorder and inorder. (9 Marks)

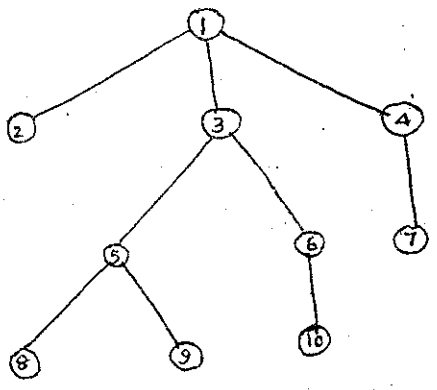


Fig. 3(b)

4. (a) Write DFS algorithm and find its worst case efficiency. (6 Marks)

   (b) Write an algorithm to topologically sort a diagraph using DFS. Prove the correctness and find the time efficiency. (8 Marks)

Contd.... 2

(c) Topologically sort the following graph shown in Fig.4(c) (6 Marks)

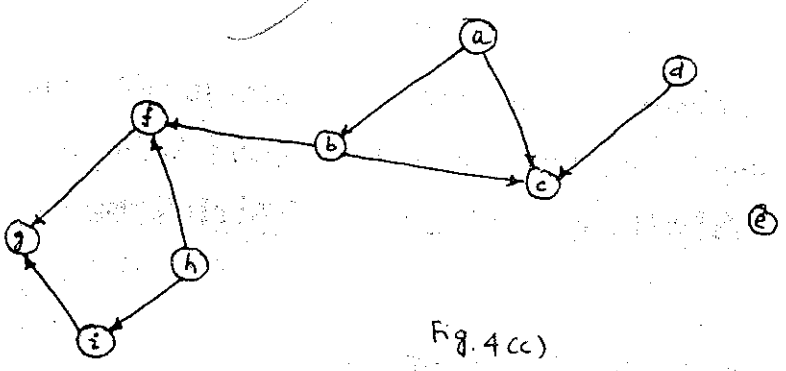


Fig. 4 (c)

5. (a) What is a 2-3 tree? Explain search, insertion and deletion operations and show that these operations are all in $\Theta(log\ n)$ in both worst and average case. (10 Marks)

   (b) What is a heap? Outline an algorithm to construct a heap. Derive the efficiency class of this algorithm. (10 Marks)

6. (a) Describe an algorithm with an example to compute binomial coefficient and derive its time efficiency. (10 Marks)

   (b) Design a $\Theta(n^2)$ algorithm for finding an optimal binary search tree. (10 Marks)

7. (a) Write the Kruskal's algorithm to find minimum spanning tree in time $O(|\ E\ |\ log\ |\ E\ |)$, where $|\ E\ |$ is the number of edges. Prove the correctness and derive the efficiency class of the algorithm. (14 Marks)

   (b) Apply Kruskal's algorithm to find minimum spanning tree of the graph shown in Fig.7(b). (6 Marks)

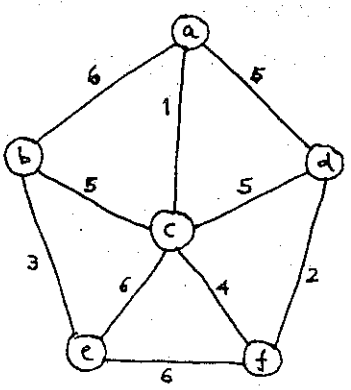


Fig. 7 (b)

8. (a) Define P, NP, and NP-complete problems. (3 Marks)

   (b) Write twice around the tree approximation algorithm for travelling salesman problem. Illustrate the working of the algorithm with an example. (10 Marks)

   (c) Show that the above algorithm is a 2 approximation algorithm. (7 Marks)

** * **

NEW SCHEME

CS43

USN | | | | | | | | | | |

Fourth Semester B.E. Degree Examination, January/February 2005

Computer Science /Information Science and Engineering

Analysis and Design of Algorithms

Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. Algorithms should be accompanied by sufficient explanations.

1. (a) With the help of a flow chart, explain the various stages of algorithm design and analysis process. **(12 Marks)**

(b) Distinguish between the two common ways to represent a graph. Given the representation of an undirected graph, explain how the following can be ascertained by the representation

i) The graph is complete

ii) The graph has a loop

iii) The graph has an isolated vertex

answer for each of the representations separately. **(8 Marks)**

2. (a) Explain the concept of asymptotic notations, indicating the normally used notations. **(8 Marks)**

(b) Suggest a general plan for analysing the efficiency of non recursive algorithms. Suggest an algorithm to find whether the elements in an array are unique. Analyse it's efficiency using the method suggested by you. **(12 Marks)**

3. (a) What is a 'bruteforce' method? Under what conditions does the method become desirable? **(6 Marks)**

(b) Discuss whether the travelling sales person problem can be solved by exhaustive search methods. **(6 Marks)**

(c) State the merge sort algorithm and analyse its complexity. **(8 Marks)**

4. (a) Suggest an algorithm based on divide and conquer methodology to multiply two large integers and analyze its performance. **(10 Marks)**

(b) Suggest an algorithm for generating combinational objects based on decrease and conquer methodology. **(10 Marks)**

5. (a) Explain the concept of 2-3 tree. How can keys be inserted into it? Comment on the efficiency of search operations on a 2-3 tree. **(10 Marks)**

(b) With the help of necessary algorithms, explain the bottom up heap sort method of sorting. **(10 Marks)**

6. (a) Explain the concept of hashing as a method of implementing dictionaries. What are the two main methods of resolving collisions? Briefly explain them. **(10 Marks)**

Contd.... 2

(b) With help of a Pseudocode, explain Warshall's algorithm to find the transitive closure of a directed graph. Apply it to the following graph

$$\begin{array}{c} \\ a \\ b \\ c \\ d \end{array} \begin{array}{c} \begin{array}{cccc} a & b & c & d \end{array} \\ \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix} \end{array}$$

(10 Marks)

7. (a) State and explain Dijkstra's algorithm to find single source shortest paths. **(10 Marks)**

(b) What is a Huffman tree? Explain an algorithm to construct the Huffman tree. **(10 Marks)**

8. (a) Explain the concept of decision trees for sorting algorithms. **(10 Marks)**

(b) What is backtracking? Explain it's usefulness with the help of an algorithm. What are the specific areas of its applications? **(10 Marks)**

** * **

NEW SCHEME

CS43

USN | | | | | | | | | | |

Fourth Semester B.E. Degree Examination, July/August 2005

Computer Science and Information Science Engineering

Analysis and Design of Algorithms

Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. Algorithms should be accompanied by sufficient explanations.

1. (a) Explain the various stages of algorithm design and analysis process with the help of a flow chart. **(10 Marks)**

   (b) Define the terms sparse and dense with reference to graph. With suitable example explain the methods used to represent sparse and dense graphs comment on space complexity of each representation. **(10 Marks)**

2. (a) Explain various asymptotic notations used in analysing algorithm. Give the examples. **(10 Marks)**

   (b) If $t_1(n) \in O(g_1(n))$ and $t_2(n) \in O(g_2(n))$ then prove the following assertion $t_1(n) + t_2(n) \in O(max\{g_1(n), g_2(n)\})$ **(5 Marks)**

   (c) With suitable example explain the significance of order of growth in analysing algorithms efficiency. **(5 Marks)**

3. (a) Suggest general plan for analysing recursive algorithms. Mathematically analyse the tower of hanoi problem and find its complexity. **(10 Marks)**

   (b) What is a brute force method? Write a brute force string matching algorithm. Explain with suitable example the correctness of that algorithm. Analyze for complexity. **(10 Marks)**

4. (a) Explain the divide and conquer methodology. Suggest a pseudocode for merge-sort and analyse its complexities. Trace algorithm to the data set 8,4,1,6,7,2,3,9. **(10 Marks)**

   (b) Briefly explain Strassen's matrix multiplication and how it uses divide and conquer method. Obtain its time complexity. **(10 Marks)**

5. (a) With suitable example, explain depth first search and breadth first search algorithms. Write the pseudocodes for both. Derive the time-complexities. Explain its use in topological sorting. **(12 Marks)**

   (b) State Horspool's algorithm for pattern matching. Apply it to search for the pattern BARBER in the given test ; consider all the 4 cases. **(8 Marks)**

6. (a) Define the three variations of transform and conquer algorithms. Construct an AVL tree for the list 5,6,8,3,2,4,7 by successive insertions. State four rotation types used in the construction of ALV tree, and explain the same. **(10 Marks)**

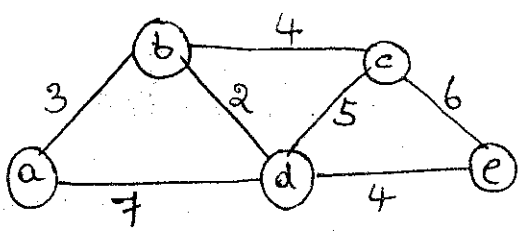
   (b) Construct heap for the list 2,9,7,6,5,8 using bottom up construction algorithm. Explain clearly procedure of adding new element in that method. Explain in brief heap sort algorithm and obtain its complexity. **(10 Marks)**

Contd.... 2

7. (a) Explain how dynamic programming is used to compute all pair shortest paths for a weighted digraph. Write the pseudocode for same and derive the time complexity. **(10 Marks)**

(b) Give Huffman's algorithm to construct Huffman tree and explain same with suitable example. **(5 Marks)**

(c) Using greedy method trace the following grpah to get shortest path from vertex *a* to all other vertices. **(5 Marks)**



8. (a) Explain backtracking concept and apply same to n-queen's problem. **(8 Marks)**

(b) Explain how TSP problem can be solved using branch and bound method. **(6 Marks)**

(c) Write brief note on P, NP and NP-complete problems. **(6 Marks)**

** * **

NEW SCHEME

CS43

Reg. No. | | | | | | | | | | |

Fourth Semester B.E. Degree Examination, January/February 2006

Computer Science and Information Science and Engineering

Analysis and Design of Algorithms

Time: 3 hrs.) (Max.Marks : 100

Note: *Answer any FIVE full questions.*

1. **(a)** Define : O - notation , Ω - notation and Θ notation.

If $f_1(n) \in O(g_1(n))$ and $f_2(n) \in O(g_2(n))$, prove that $f_1(n) + f_2(n) \in O(max[g_1(n), g_2(n)])$. **(8 Marks)**

(b) Develop an algorithm to determine the minimum and maximum values in an array $a_1, a_2, ..., a_n$ of integers (Here $n \geq 1$ and the entries in the array need not be distinct). Determine worst-case complexity function for this algorithm. **(7 Marks)**

(c) What is wrong with the following argument ?
"Since $n = O(n)$, $2n = O(n)$,... we have

$$\sum_{1 \leq k \leq n} kn = \sum_{1 \leq k \leq n} O(n) = O(n^2)"$$ **(5 Marks)**

2. **(a)** Design a brute-force algorithm for computing the value of a polynomial

$$p(x) = a_n x^n + a_{n-1} x^{n-1} + ... + a_1 x + a_0$$

at a given point x_0 and determine its worst - case complexity class. **(6 Marks)**

(b) If the algorithm designed in part (a) is in $\Theta(n^2)$, design a linear algorithm for this problem. **(6 Marks)**

(c) Write quick sort algorithm. Derive worst - case and average - case complexities for this algorithm. **(8 Marks)**

3. **(a)** Write a decrease - by - one algorithm to generate all 2^n subsets of a set $\{a_1, a_2, ..., a_n\}$ in quashed order i.e. subset involving a_j can be listed only after all subsets involving $a_1, a_2, ...a_{j-1}$ $(j = 1, 2, ...n-1)$ **(7 Marks)**

(b) Design a decrease - by - one algorithm for generating a gray code of order n. **(6 Marks)**

(c) Solve the system of linear equations given below by Gaussian elimination :

$$2x_1 - x_2 + x_3 = 1$$
$$4x_1 + x_2 - x_3 = 5$$
$$x_1 + x_2 + x_3 = 0$$ **(7 Marks)**

4. **(a)** Define a heap. Prove that a n-element heap has height $[log\ n]$. Show that there is a linear algorithm to construct a heap of size n. **(16 Marks)**

(b) What is the running time of heapsort on an array A of length n that is already sorted in increasing order ? What about decreasing order ? **(4 Marks)**

Contd.... 2

5. **(a)** What is input enhancement ? Apply this technique to design a linear sorting algorithm. **(8 Marks)**

(b) When does collision occur in hashing ? What are different mechanisms used to resolve collisions ? **(4 Marks)**

(c) Consider open hashing with linear probing policy. For the input : 1055, 1492, 1776, 1812, 1918, 1945 inserted in the order and hash function : $h(k) = 5k(mod\ 8)$

i) Construct the open hash table

ii) Show the sequence of key comparisons needed to search for 1945 and 1543 in the table. **(8 Marks)**

6. **(a)** Write Warshall's algorithm to find transitive closure of a digraph. Prove that the time complexity of the algorithm is $\Theta(n^3)$. **(10 Marks)**

(b) Apply Warshall's algorithm to find transitive closure of the digraph defined by the following adjacency matrix.

$$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix}$$

(10 Marks)

7. **(a)** What is a decision tree ? Use decision trees to establish lower bound on worst-case and average - case efficiency of comparison based sorting algorithm. **(10 Marks)**

(b) Define NP - complete problem. Prove that the Hamiltonion circuit problem is polynomially reducible to the decision version of traveling salesman problem (TSP). **(10 Marks)**

8. **(a)** What is a C - approximation algorithm ? Write a 2 - approximation algorithm for TSP with Euclidian distances. **(10 Marks)**

(b) If $P \neq NP$. Prove that there exists no C - approximation algorithm for TSP. **(10 Marks)**

** * **

CS43

USN

NEW SCHEME

Fourth Semester B.E. Degree Examination, July 2006
CS/IS
Analysis and Design of Algorithm

Time: 3 hrs.] [Max. Marks:100

Note: *1. Answer any FIVE full questions.*

1 a. With a neat diagram, briefly explain the design and explain the design and analysis of an algorithm. **(07 Marks)**

b. Explain what property of the adjacency matrix of an undirected graph indicates that the graph is complete has loop / has an isolated vertex. **(03 Marks)**

c. Design a recursive algorithm for computing 2^n for a non negative integer n, based on the formula $2^n = 2^{n-1}+2^{n-1}$. Set up a recurrence relation for the number of additions made by the algorithm and solve it. For n = 5, draw a tree of recursive calls for this algorithm and count the number of calls. **(10 Marks)**

2 a. Explain how we can compare the order of growth of 2 functions using limits. Compare order of growth of $\log_2 n$ and $\sqrt{n}$. **(07 Marks)**

b. Define asymptotic notations O, θ, Ω and prove that $\frac{1}{2} n(n-1) \in \theta(n^2)$. **(08 Marks)**

c. Sort the list 'QUESTION' in alphabetical order using the Bubble Sort algorithm. **(05 Marks)**

3 a. Write down an algorithm to search for a key in a given array, using linear search. Find its best, worst and average case efficiencies. **(10 Marks)**

b. State whether the following are true or false:
$n^2+n+5 \in O(n^3)$, $n^2+1 \in O(10000n)$, $n^2+5 \in \theta(n^2)$, $n^2+1 \in \Omega(n)$. **(02 Marks)**

c. Apply Quick Sort to sort the list 'QUESTION' in alphabetical order. Draw the tree of the recursive calls made. **(08 Marks)**

4 a. Write down a recursive algorithm to compute the number of leaves in a binary tree. **(05 Marks)**

b. Prove the correctness of the above algorithm in Q4(a). **(05 Marks)**

c. Write an algorithm for DFS and explain how it can be used to solve topological sorting problem, with an example. **(10 Marks)**

5 a. Design a presorting – based algorithm to find the mode and determine its efficiency class. **(07 Marks)**

b. Construct an AVL tree by inserting the elements successively, for 3,6,5,7,1,2,8,4, staring from an empty tree. **(05 Marks)**

c. Write down an algorithm to construct a heap by bottom-up method. Trace your algorithm for the list 1,8,6,5,3,7,4. **(08 Marks)**

Contd... 2

6 a. Construct a shift table for the pattern BAOBAB, and search for the same in the text BESS-KNEW-ABOUT-BAOBABS, using Horspool's algorithm. **(06 Marks)**

b. Briefly explain the dynamic programming technique using Floyd's algorithm for the problem of all-pairs, shortest path as an example. **(07 Marks)**

c. What are the requirements to be satisfied to apply greedy technique? Explain Prim's algorithm with a suitable example. **(07 Marks)**

7 a. Construct a Huffman code for the following data:

Character	A	B	C	D	E
Probability	0.4	0.1	0.2	0.14	0.16

Encode the text ABACABAD using the above code. Decode the text whose encoding is 100010111001010, using the above Huffman code. **(07 Marks)**

b. What is back tracking? Apply back tracing algorithm to solve the instance of the sum-of-subset problem S={1,3,4,5} and d=11. **(07 Marks)**

c. With the help of a state-space tree, solve the following instance of the Knapsack problem by the branch-and-bound algorithm. **(06 Marks)**

Item	Weight	Value
1	10	100
2	7	63
3	8	56
4	4	12

W = 16

8 a. What is the need for approximate algorithms? Explain, with a suitable example, the nearest neighbour algorithm. **(10 Marks)**

b. Write down the decision tree for the three-element insertion sort.

c. Define the following: **(06 Marks)**
Decision problem, Class of NP problems, NP-Complete problem and Polynomially reducible problems. **(04 Marks)**

*****

CS43

USN | | | | | | | | | | |

NEW SCHEME

Fourth Semester B.E. Degree Examination, Dec. 06 / Jan. 07
C S / I S
Analysis and Design of Algorithms

Time: 3 hrs.] [Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. What is an Algorithm? Illustrate the important points to be noted with respect to an algorithm, with an example. **(06 Marks)**

b. Describe the standard algorithm for finding the binary representation of a positive decimal integer with a neat pseudo code. **(06 Marks)**

c. Design an algorithm for checking whether two given words are anagrams, for example the words 'tea' and 'eat' are anagrams. i.e. one word can be obtained by permuting the letters of the other. **(08 Marks)**

2 a. For the following algorithms, indicate i) Natural size metric for its inputs ii) Basic operations iii) Whether the basic operations count can be different for inputs of the same size. **(08 Marks)**

1) Computing sum of 'n' numbers 2) Computing x^n.

3) Finding largest element in a list of 'n' numbers. 4) Euclid's algorithm.

b. Find the Big – on notation for the following : **(06 Marks)**

i) $\log n + \sqrt{n}$ ii) $n + n \log n$ iii) $6n + 2n^4 + 4n^5$

c. Find the time efficiency of the definition based algorithm for computing product of n x n matrices. **(06 Marks)**

3 a. Design a brute – force algorithm for computing the value of a polynomial $P(x) = a_n x^n + a_{n-1} x^{n-1} + ... + a_1 x + a_0$ at a given 'x_0' and determine it's worst case efficiency class. **(08 Marks)**

b. Sort the list { E, X, A, M, P, L, E } in alphabetical order using insertion sort. **(06 Marks)**

c. Give the pseudo code for finding maximum and minimum element in an array of 'n' numbers using divide – and – conquer technique. **(06 Marks)**

4 a. Draw the tree of recursive calls made to sort the elements { C,O, M, P, U, T, I, N, G } in alphabetical order using Quick sort method. **(10 Marks)**

b. Apply Strassen's algorithm to compute, using 2x2 matrices, exiting the recursion when n = 2. **(10 Marks)**

$$\begin{bmatrix} 1 & 0 & 2 & 1 \\ 4 & 1 & 1 & 0 \\ 0 & 1 & 3 & 0 \\ 5 & 0 & 2 & 1 \end{bmatrix} * \begin{bmatrix} 0 & 1 & 0 & 1 \\ 2 & 1 & 0 & 4 \\ 2 & 0 & 1 & 1 \\ 1 & 3 & 5 & 0 \end{bmatrix}$$

5 a. Apply the D F S – based and source removal methods to obtain the topological sorting of the following graph. **(10 Marks)**

Contd...2

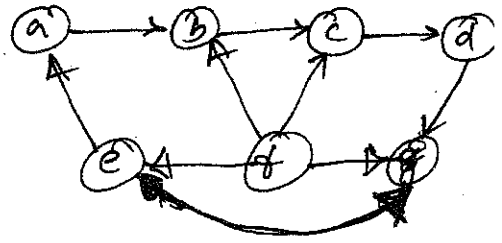


Fig.5(a)

b. Construct the A V L tree and 2 – 3 tree for the input sequence : 3 6 5 1 2 4 **(10 Marks)**

6 a. Sort the elements { S, O, R, T, I, N, G } in alphabetical order using Heapsort method. **(10 Marks)**

b. Construct the open hash table and closed hash table for the input : 30, 20, 56, 75, 31, 19 using the hash function h (k) = k mod 11 **(10 Marks)**

7 a. Apply Floyd's algorithm to compute all – pairs shortest paths for the following graph. **(10 Marks)**

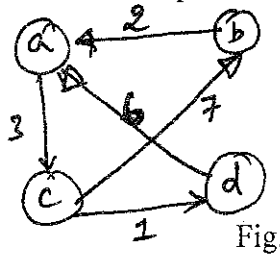


Fig. 7(a)

b. Apply Kruscal's algorithm to find a minimum spanning tree of the following g ph. **(0(Iarks)**

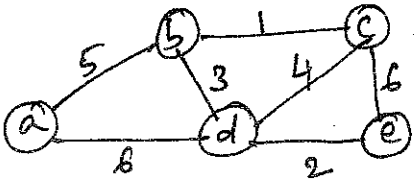


Fig. 7(b)

c. Construct a Huffman code for the following data. **(04 Marks)**

Character	A	B	C	D	-
Probability	0.4	0.1	0.2	0.15	0.15

8 a. Prove that the classic recursive algorithm for the Tower of Hanoi problem makes the smallest member of disk moves needed to solve the problem. **(06 Marks)**

b. Draw the state – space tree for solving 4-Queens problem using back tracking. **(04 Marks)**

c. Solve the following instance of the Knapsack problem by the branch – and – bound algorithm. **(10 Marks)**

Item	Weight	Value
1	10	$ 100
2	7	$ 63
3	8	$ 56
4	4	$ 12

W = 16

*****

CS43

USN | | | | | | | | | | |

NEW SCHEME

Fourth Semester B.E. Degree Examination, July 2007
CS / IS
Analysis and Design of Algorithm

Time: 3 hrs.] [Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. With the help of a flowchart, explain the various stages of algorithm design and analysis process. **(08 Marks)**

b. List the different problem types and name one algorithm of each type. **(07 Marks)**

c. Distinguish between the two common ways to represent a graph. Given the representation of undirected graph how do you ascertain that the graph is
i) Weighted ii) Connected iii) Cyclic. **(05 Marks)**

2 a. Explain in brief the basic asymptotic efficiency classes. **(08 Marks)**

b. Indicate whether the first function of each of the following pairs has a smaller, same or larger order of growth than second function
i) $n(n+1)$ and $2000n^2$ ii) $100n^2$ and $0.01n^3$ iii) $\log_2 n$ and $\ln n$
iv) 2^{n-1} and 2^n v) $\log_2 n$ and $\log_2 n^2$ vi) $(n-1)!$ and $n!$ **(06 Marks)**

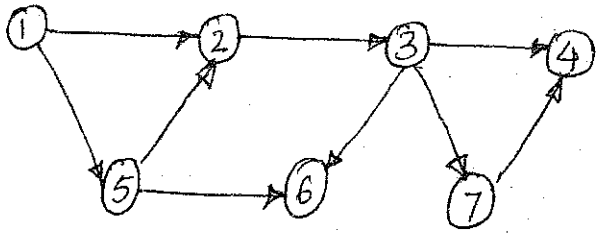
c. Explain the concept of asymptotic notations indicating the normally used notations. **(06 Marks)**

3 a. What is Brute force method? Write a Brute force string matching algorithm. Explain with suitable example the correctness of that algorithm. Analyse for complexity. **(10 Marks)**

b. List the sorting algorithms which use divide and conquer technique for sorting the elements. Write and analyse any one algorithm for sorting. Also give constraints of each algorithm. **(10 Marks)**

4 a. Differentiate between depth first search and breadth first search techniques. **(05 Marks)**

b. What are the basic differences in representing the directed and undirected graph? Apply the depth first search based algorithm to solve the topological sorting problem for the following diagraph.



c. Write the Johnson Trotter algorithm for generating permutation of the given set of numbers. Also generate all permutations of {3, 5, 7} by : **(05 Marks)**
i) The bottom up minimal change algorithm
ii) The Johnson Trotter algorithm
iii) The lexicographic order algorithm. **(10 Marks)**

Contd.... 2

5 a. Explain "Transform and Conquer" technique. What are the 3 major variations of this idea? **(05 Marks)**

b. The time efficiency of searching, inserting and deleting in a binary search tree is $\theta(\log n)$ in the average case. It degenerates to $\theta(n)$ in the worst case. How is it overcome using transform and conquer technique? Explain both techniques by re-arranging the given data :

i) 7, 8, 10, 5, 4, 6, 9

ii) C, O, M, P, U, T, I, N, G **(10 Marks)**

c. Write and analyse the Horspool matching algorithm for searching a given pattern in a string. **(05 Marks)**

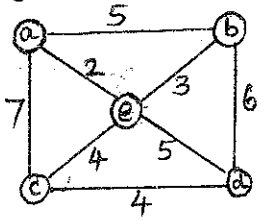
6 a. Write and explain the functions of Warshall's and Floyd's algorithm. **(10 Marks)**

b. Explain how the drawbacks of top-down and bottom-up approach of dynamic programming are overcome using memory functions. Apply the memory function method to solve the instance of the knapsack problem given below :

Item	Weight	Value
1	3	$25
2	2	$20
3	1	$15 Capacity W = 6
4	4	$40
5	5	$50

i) Indicate the entries of the dynamic programming table that are never computed by the memory function method on this instance. **(10 Marks)**

7 a. What is greedy technique? Explain how the different steps of this technique are taken care in generating a minimum spanning tree through a sequence of expanding subtrees. Apply this algorithm to the following graph.



(10 Marks)

b. Write Kruskal's algorithm. What are its applications? How is it different from prim's algorithm? **(05 Marks)**

c. Construct a Huffman code for the following data :

Character	A	B	C	D	-
Probability	0.4	0.1	0.2	0.15	0.15

Using this code encode the code

A B C D – A B A C **(05 Marks)**

8 a. Distinguish between P, NP and NP complete problems. Give examples for each category. **(05 Marks)**

b. Apply backtracking to solve the following instance of the subset sum problem

S = { 2, 3, 4, 5 } and d = 11

Will the backtracking algorithm work correctly if we use just one of the two in equalities to terminate a node as non-promising. **(05 Marks)**

c. Write short notes on :

i) Backtracking

ii) Branch and bound technique. **(10 Marks)**

*****

USN | | | | | | | | | | |

CS43

Fourth Semester B.E. Degree Examination, Dec. 07 / Jan. 08
Analysis and Design of Algorithms

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. What do you mean by a stable algorithm and an algorithm is inplace? Explain the same and give an algorithm to sort a given list of numbers which should be stable but not inplace **(08 Marks)**

b. What are the differences between set and multiset? Compare it with list. Explain with example two ways of defining sets. **(06 Marks)**

c. Give three different algorithms to compute gcd of given two positive numbers and comment on their performance. **(06 Marks)**

2 a. Define the commonly encountered asymptotic notations and illustrate with figures. Express the following functions using asymptotic notations :

i) $6 * 2^n + n^2$ ii) $\frac{1}{2}n(n-1)$

Give the necessary steps to prove the same. **(10 Marks)**

b. Give the general plan for analyzing the recursive algorithms. Mathematically analyse the tower of Hanoi problem, clearly indicating the steps and comment on its complexity. **(10 Marks)**

3 a. What is brute force method? Explain the exhaustive search technique. How would you apply it to a job assignment problem? Explain with suitable example. Analyse for complexity. **(08 Marks)**

b. Give the general divide and conquer recurrence and explain the same. Give the Master' s theorem and explain with example how would you apply it to solve the recurrence. **(06 Marks)**

c. Using complexity analysis prove that Strassen's matrix multiplication algorithm is more efficient compared to conventional matrix multiplication for large values of n. **(06 Marks)**

4 a. Explain the concepts of divide and conquer methodology indicating three major variations of same. **(06 Marks)**

b. With suitable example explain Johnson trotter algorithm to generate permutation of given objects. **(06 Marks)**

c. Give BFS and DFS algorithm. Clearly bring out the differences and comment on the complexity. **(08 Marks)**

5 a. What is an AVL tree? Explain four types of rotations used to construct AVL tree. Construct an AVL tree for the list 5, 6, 8, 3, 2, 4, 7 showing clearly successive insertions. **(10 Marks)**

b. What is a heap? Give an algorithm to construct a heap for the elements of given array by bottom up approach. What is its complexity? Show heap construction for the given list 2, 9, 7, 6, 5, 8 stage by stage. **(10 Marks)**

6 a. With suitable example explain Boyer-Moore algorithm used in string matching. **(08 Marks)**

b. Explain the concept of dynamic programming. With a suitable example explain an algorithm to solve all pair shortest path problem. Discuss about its complexity. **(12 Marks)**

7 a. Justify the statement "Prim's algorithm always yields minimum cost spanning tree". Give the Prim's algorithm and discuss about its complexity. **(08 Marks)**

b. What is a Huffman tree? Explain it with suitable example and give Huffman's algorithm. **(06 Marks)**

c. Give Dijkstra's algorithm. What is its complexity? Discuss with a simple example. **(06 Marks)**

8 a. Explain backtracking concept and apply the same to n-queen's problem. **(08 Marks)**

b. Write notes on :

i) Branch and bound method ii) P, NP and NP complete problems. **(12 Marks)**

*****

USN | | | | | | | | | | |

06CS43

Fourth Semester B.E. Degree Examination, Dec 08 / Jan 09
Analysis and Design of Algorithms

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions, selecting atleast TWO questions from Part A and Part B.***

PART - A

1 a. Discuss the various stages of algorithm design and analysis process using flow chart. **(10 Marks)**

b. Explain important fundamental problem types of different category. **(10 Marks)**

2 a. Explain in brief the basic asymptotic efficiency classes. **(06 Marks)**

b. Explain the method of comparing the order of the growth of two functions using limits. Compare order of growth of following functions i) $\log_2 n$ and $\sqrt{n}$ ii) $(\log_2 n)^2$ and $\log_2 n^2$. **(09 Marks)**

c. Discuss the general plan for analyzing efficiency of non recursive algorithms. **(05 Marks)**

3 a. What is brute – force method? Explain sequential search algorithm with an example. Analyse its efficiency. **(10 Marks)**

b. Write the merge sort algorithm and discuss its efficiency. Sort the list E, X, A, M, P, L, E in alphabetical order using merge sort. **(10 Marks)**

4 a. What is divide – and – conquer technique? Apply this method to find multiplication of integers 2101 and 1130. **(08 Marks)**

b. Explain the differences between DFS and BFS. Solve topological sorting problem using DFS algorithm with an example. **(12 Marks)**

PART - B

5 a. Explain bottom – up heap sort algorithm with an example. Analyse its efficiency. **(10 Marks)**

b. Write Horspool's algorithm. Apply Horspool algorithm to search for the pattern BAOBAB in the text BESS_ KNEW_ABOUT_BAOBABA. **(10 Marks)**

6 a. Write Warshall's algorithm. Apply Warshall's algorithm to find the transitive closure of the following Fig. 6(a). **(10 Marks)**

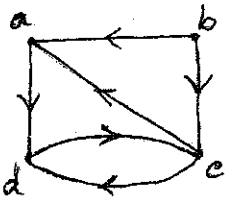


Fig. 6(a)

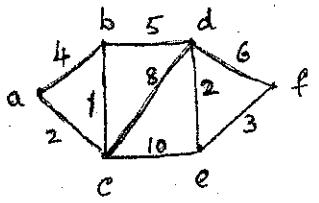


Fig. 7(a)

b. Solve the following knapsack problem with given capacity W = 5 using dynamic programming. **(10 Marks)**

Item	Weight	Value
1	2	$12
2	1	$10
3	3	$20
4	2	$15

7 a. Write Dijkstra's algorithm and apply the same to find single source shortest paths problem for the following graph taking vertex 'a' as source in fig. 7(a). **(10 Marks)**

b. What are decision trees? Explain the concept of decision trees for sorting algorithms with an example. **(10 Marks)**

8 a. Briefly explain the concepts of P, NP and NP complete problems. **(10 Marks)**

b. Explain back – tracking algorithm. Apply the same to solve the following instance of the subset – sum problem : S = {3, 5, 6, 7} and d = 15. **(10 Marks)**

PART – B

5 a. Design a Presorting – based algorithm to find the distance between the 2 closest numbers in an array of 'n' numbers. Compare the efficiency of this algorithm. With that of brute – force algorithm. **(10 Marks)**

b. Construct AVL tree for the set of elements – 5, 6, 8, 3, 2, 4, 7. **(06 Marks)**

c. Apply Horspool's algorithm to search for the pattern BAOBAB in the text
BESS␣KNEW␣ABOUT␣BAOBABS
Also, find the total number of comparisons made. **(04 Marks)**

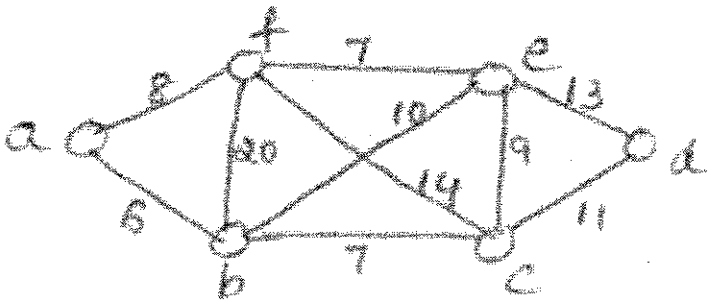
6 a. For the input – 30, 20, 56, 75, 31, 19 construct the open hash table. Find largest and average number of key comparisons in a successful search in the table. **(06 Marks)**

b. Explain Dynamic programming. **(04 Marks)**

c, Write the formula to find the shortest path using Floyd's approach. Use Floyd's method to solve the below all-pairs shortest paths problem. **(10 Marks)**

$$\begin{bmatrix} 0 & \infty & 3 & \infty \\ 2 & 0 & \infty & \infty \\ \infty & 7 & 0 & 1 \\ 6 & \infty & \infty & 0 \end{bmatrix}$$

7 a. Use Kruskal's method to find min cost spanning tree for the below graph. **(06 Marks)**



b. Write Huffman tree construction algorithm. **(08 Marks)**

c. Draw the decision tree for the 3 – elements insertion sort. **(06 Marks)**

8 a. Differentiate between back tracking and Branch – and – bound algorithm. **(06 Marks)**

b. Draw the state space tree to generate first solution to 4 – queens problem. With the first solution, generate another solution, making use of board's symmetry. **(08 Marks)**

c. Explain P and NP problems. **(06 Marks)**

* * * * *

USN | | | | | | | | | | |

2002 SCHEME

CS43

Fourth Semester B.E. Degree Examination, June-July 2009
Analysis and Design of Algorithms

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Compare adjacency matrix and adjacency list methods of representing graphs. Give examples. **(08 Marks)**

b. Write two separate algorithms to compute the indegree and outdegree of a directed, connected graph, which is represented as adjacency list. **(12 Marks)**

2 a. Define the following asymptotic notations: O, Θ, Ω. **(06 Marks)**

b. Prove the following, using limit theory:

i) $\log_2(n!)=\Omega(n\log_2 n)$ ii) $\sqrt{10n^2+7n+3}=\Theta(x)$ **(06 Marks)**

c. Write an iterative/recursive algorithm to find a^n and determine the time taken by your algorithm (apply brute-force method). **(08 Marks)**

3 a. Show the steps in sorting the list using quicksort: 60, 50, 20, 80, 10, 90, 30, 70, 40. **(05 Marks)**

b. Using divide-and-conquer approach, write an algorithm for Quicksort and derive the best, worst, and average complexity of the same. **(15 Marks)**

4 a. Write DFS and BFS trees for the following graph: **(08 Marks)**

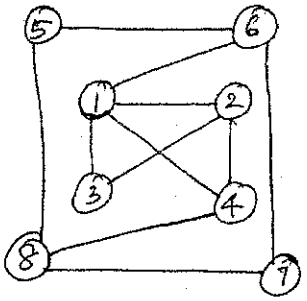
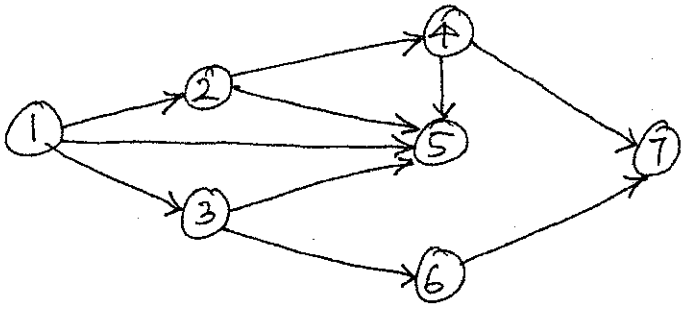


Fig. Q4 (a)

b. Write an algorithm or C/C++ program to find the path between any two given vertices u and v of an undirected graph G = {V, E} based on DFS. You must print all the vertices appearing between u and v. Note that the path need not be the shortest. **(12 Marks)**

5 a. What do you understand by Topological sort? Give its applications. Apply source removal method to find the topological order of the following graph: **(10 Marks)**



b. An efficient algorithm to generate all permutations of a positive integer n is by using Johnson-Trotter algorithm. Show the algorithm and all the intermediate steps for n = 3. Suggest the best data structure to implement this algorithm. **(10 Marks)**

6 a. Show how would you sort the following list using Heapsort algorithm:
34, 12, 89, 34, 21, 12, 64, 10 **(05 Marks)**

b. Explain the Horspool algorithm by taking an appropriate example. **(05 Marks)**

c. Devise a dynamic programming based algorithm for finding the all-pairs shortest path of a given connected, directed graph G. Trace your algorithm for the below given cost matrix. **(10 Marks)**

	1	2	3	4
1	0	∞	3	6
2	2	0	∞	4
3	∞	7	0	1
4	∞	∞	∞	0

7 a. Let G = {V, E} be an undirected, connected graph. Write the Prim's algorithm that finds the minimum spanning tree based on greedy technique. Give an example of a 5 vertex graph to illustrate its working. **(10 Marks)**

b. Apply backtracking to solve the following instance of sum-of-subset problem:
S = {1, 5, 2, 7} with d = 8 **(10 Marks)**

8 a. Solve the following problem using Branch and Bound technique: **(10 Marks)**

Job

Persons	Job1	Job2	Job3	Job4
A	9	2	7	8
B	6	4	3	7
C	5	8	1	8
D	7	6	9	4

b. Discuss the approximation algorithms for NP-hard problems. **(10 Marks)**

* * * * *

USN | | | | | | | | | | |

06CS43

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Analysis and Design of Algorithms

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

Part – A

1 a. Explain the various stages of algorithm design and analysis process using a flow chart. **(10 Marks)**

b. Define the following:
i) Special types of list.
ii) Paths and Cycles.
iii) Sets and Dictionaries. **(06 Marks)**

c. Write an algorithm to find the distance between two closest elements in an array of numbers. **(04 Marks)**

2 a. Prove that :: If $t_1(n) \in O(g_1(n))$ and $t_2(n) \in O(g_2(n))$
then $t_1(n) + t_2(n) \in O(\max\{g_1(n), g_2(n)\})$ **(06 Marks)**

b. Write an algorithm to compute n! recursively. Set up a recurrence relation for the algorithm's basic operation count and solve it. **(08 Marks)**

c. Explain the method of comparing the order of the growth of 2 functions using limits. Compare order of growth of $\log_2 n$ and $\sqrt{n}$. **(06 Marks)**

3 a. Discuss how quick sort works to sort an array and trace for the following data set. Draw the tree of recursive calls made. 1, 1, 9, 9, 5, 5, 6, 6 **(10 Marks)**

b. What is stable algorithm? Is Quick Sort stable? **(02 Marks)**

c. Write the algorithm for binary search and find the average case efficiency. **(08 Marks)**

4 a. Explain the difference between DFS and BFS. Solve topological sorting problem using DFS algorithm, with an example. **(12 Marks)**

b. Show the steps in multiplying the following 2 integers using efficiency integer multiplication method: 5673 × 6342. **(08 Marks)**

Part – B

5 a. What is an AVL tree? Explain the need for rotation of AVL tree. Construct an AVL tree for the list 10, 20, 30, 25, 27, 7, 4 by successive insertion. **(10 Marks)**

b. Write an algorithm for comparison counting and show how comparison counting method sorts the list: 45, 2, 19, 10, 33, 22, 1, 23 **(10 Marks)**

6 a. Explain hashing and various collision resolution techniques. **(06 Marks)**

b. Solve the all pairs shortest path problem for the diagraph with the weight matrix. **(10 Marks)**

$$\begin{bmatrix} 0 & 2 & \infty & 1 & 8 \\ 6 & 0 & 3 & 2 & \infty \\ \infty & \infty & 0 & 4 & 8 \\ \infty & \infty & 2 & 0 & 3 \\ 3 & \infty & \infty & \infty & 0 \end{bmatrix}$$

c. Using dynamic programming, solve the following knapsack instance:
$n = 3, [\omega_1, \omega_2, \omega_3] = [1, 2, 2]$ and $[P_1, P_2, P_3] = [18, 16, 6]$ and $M = 4$ **(04 Marks)**

7 a. Solve the following instances of the single source shortest path problem with vertex 'a' as the source. **(06 Marks)**

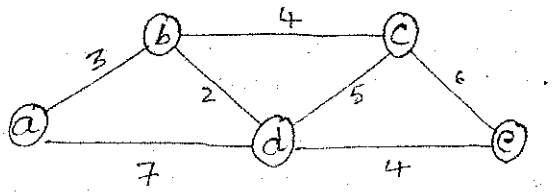


Fig. Q7 (a)

b. Write the Kruskal's algorithm to find the minimum cost spanning tree. Also trace the algorithm for the graph of figure Q7 (b). **(10 Marks)**

c. What are Huffman codes and trees? Discuss the advantage of Huffman's code. **(04 Marks)**

8 a. Discuss p and np problems. **(05 Marks)**

b. What is the central principle of back tracking? Taking n-queens problem as an example, explain the solution process. **(05 Marks)**

c. What is branch and bound? How is it different from back tracking? **(05 Marks)**

d. Draw the state space tree for the sum of subset problem of the instance:
S = {5, 7, 8, 10} and d = 15 **(05 Marks)**

* * * * *