

BITS, Pilani – Dubai Campus, Knowledge Village, Dubai.
III Year First Semester 2003-2004

Degree: B.S. Branch: C.S.E.

Comprehensive Examination Question Paper

Course No : CSUC341 Course Title: Data Structures and Algorithms
Date: 08, Jan., 2004 Thursday Time: 10 a.m.- 1 Noon Total marks: 100
Data provided are complete. *Closed Book.*

Part A

Answer **all** Questions.

10 * 2 = 20 Marks

1. What is Big O Notation? Give an example.
2. What is the average case and worst case time complexity of HEAPSORT?
3. Define a Binary Tree.
4. Define the following methods w.r.t. a Sequence ADT:
a) atRank(r) b) rankof(p)
5. What is Collisions in Hashing?
6. What is an AVL Tree?
7. Define the SIZE PROPERTY and DEPTH PROPERTY of a (2, 4) Tree.
8. What is a SUFFIX TRIE of a string X ?
9. State the LCS (Longest Common Subsequence) Problem.
10. What is CNF – SAT (CNF Satisfiability) ?

Part B

Compulsory Question

1 * 15 = 15 Marks

1. Trace through the successive passes (steps) of QUICKSORT for sorting the elements in ascending order for the input array A given below:

A = [42, 23, 74, 11, 65, 58, 94, 36, 99, 87]

(15 Marks)

Part C

Answer any **Five** Questions

5 * 13 = 65 marks

1. Write the ALGORITHM(s) to perform the following operations on a STACK:
(Assume a suitable data structure for representing a stack)
a) PUSH [Insert at least 5 strings].
b) POP [display the strings in LIFO order]. [7+6 marks]
2. Write the KRUSKAL's algorithm for constructing a Minimum Spanning Tree for a connected, undirected, weighted graph G. Trace through the algorithm with an example. [7 +6 marks]
3. Illustrate BFS (Breadth First Search) Traversal Technique in a Directed Graph with an example. [algorithm not required]. 13 marks

4. Explain the following cases for SPLAY Trees with an example for each:
 a) ZIG – ZIG b) ZIG – ZAG c) ZIG
 [4+5+4 marks]
5. Write the Algorithm for the Fractional Knapsack Problem, using the greedy method. Trace through the above algorithm for a Test Case [example].
 [8 + 5 marks]

6. The relative frequency of eight letters are given below:

Letter	E	L	Y	U	C	N	R	I
Rel. Frequency	24	7	3	32	38	44	44	120

Construct the HUFFMAN Coding Tree step by step for the above letters. [13]

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TEST I Question Paper *Makeup*

Course No : CS UC341 Course Title: Data Structures & Algorithms.
Date: *13/11/03* Time: *12-12.50* Total marks: 20

Data provided are complete. *Closed Book.*

Answer all questions.

1. Write the Recurrence equation for the Towers of Hanoi Problem and obtain an expression for the total number of moves. [5]
2. Write an algorithm to perform the following:
 - a) Read 25 positive integers in an array.
 - b) Find all pairs of elements whose sum is 25 and display them. [5]
3. What is the Average-Case Time Complexity of MERGESORT?
Analyze the Worst-Case Time Complexity of MERGESORT. [5]
4. Explain PRE-ORDER, POST-ORDER and IN-ORDER Traversal of a Binary Tree for the following expression:

$[a + (b - c)] * [(d - e) / (f + g - h)]$ [5]

Course File

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TEST I Question Paper

Course No : CS UC341 Course Title: Data Structures & Algorithms
Date: 26, Oct., 2003 Sunday Time: 10 a.m.- 10.50 a.m. Total marks: 20
Data provided are complete. **Closed Book.**

Answer all questions.

1. Write an algorithm to read a positive integer in Decimal System [Base 10] and convert it into an equivalent number in Hexadecimal System [Base 16].

Ex.:

$$\begin{array}{ccc} 26 & = & 1A \\ 10 & & 16 \end{array}$$

[5 Marks]

2. Trace through the successive passes of MERGESORT for the following input Data:

66, 33, 40, 22, 55, 88, 60, 11, 80, 20, 50, 44, 77, 30, 107, 308, 207, 408, 300, 200.

[5 Marks]

3. Define BIG O Notation? Give an example. [2]
4. What is a Binary Search Tree ? [2]
5. Define Recursion. Mention any one application that uses Recursion. [2]
6. What are the Worst-Case and Average-Case Time Complexities of QUICKSORT? [2]
7. Mention the names of *any four methods* for the *LIST* ADT. [2]

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TEST II Question Paper

Course No : CS UC341 Course Title: Data Structures & Algorithms

Date: 30, Nov., 2003 Sunday Time: 9.30 a.m. - 10.20 a.m. Total marks: 20

Data provided are complete. ~~Closed Book~~ Open Book

Answer all questions.

1. Show the Successive steps of HEAPSORT for sorting the elements in ascending order for the array given below:

A = [27, 10, 16, 12, 33, 22, 44]

(5 marks)

2. Consider the Adjacency Matrix for a directed graph G shown below:

	A	B	C	D	E
A	0	0	1	0	1
B	0	0	0	0	0
C	0	0	0	1	1
D	0	1	0	0	1
E	0	1	0	0	0

a) Draw the Graph G.

[2 Marks]

b) Using DFS, find all nodes that are reachable from D and Print them. [3 marks]

3. Find the **minimum number of multiplications** required for the MATRIX Chain-Product $A = A_0 \times A_1 \times A_2 \times A_3$ step by step,

using Dynamic Programming or any other method. The dimensions of the Matrices are given as follows:

$A_0 = (2 \times 3)$ $A_1 = (3 \times 4)$ $A_2 = (4 \times 5)$ $A_3 = (5 \times 2)$

(4 marks)

4. For the fractional Knapsack Problem, Write the Objective Function and the constraints. (2 marks)

5. Mention the names of any two fundamental methods supported by the ADT Dictionary D. (2 marks)

6. Define a) Hash Code b) Compression Map. (2 marks)

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QUIZ

Course No : CS UC341 Course Title: Data Structures and Algorithms

Date: 17, Dec., 2003 Wednesday Time: 11 a.m.- 11.30 a.m. Total marks: 10

Weightage: 5% Venue : Room 210 *Closed Book.*

IDNO:

Name:

Write answers in the space provided in question paper. Answer all 10 questions.

Note: _____ means one or more words to be filled within a line.

1. Mention the name of the *design technique / method* used by the KRUSKAL's algorithm.

2. The *time complexity* [running time] of FLOYD-WARSHALL algorithm for *all pairs shortest paths* problem with *input size n* is of the order of

3. The *depth property* in 2-4 tree states that

4. The height of an AVL TREE storing *n items* is of the order of

5. In a Skip List comprising of series of Lists, the *special keys* in the sublists are
Denoted as _____
6. Given a weighted, undirected graph G, a _____
is a Tree T, that contains all the vertices in G and minimizes the sum of the weights of the edges of T.
7. Mention the name of the *design technique / method* used by the FLOYD-WARSHALL algorithm for *all pairs shortest paths*:

8. The *size property* in 2-4 tree states that every node has at most

9. In an AVL tree T, for every internal node *v* of T, the heights of the children of V can differ by at most _____
10. The average [expected] running time for searching a *key k* in *skip-list* with *n items* is of the order of _____

BITS Pilani – Dubai campus, Knowledge Village, Dubai.
Course: CS UC341 Data Structures and Algorithms
Laboratory Assignment
Faculty : Dr. B. Vijayakumar

Evaluation: DEMONSTRATION ON 30/10/2003

LAB record should be maintained

Record should contain: Algorithm, Program Listing, and Output Results

Record submission date: 3/11/03

1. Write an Algorithm and C/C++ program to perform the following:
 - a) READ in an array of N integer values.
 - b) Use QUICKSORT to sort the input array.
 - c) Display the sorted list Weightage : 5%
2. Write an algorithm and C/C++ program for the following problem:
 1. Create a Binary Search Tree to store <IDNo, Name, CGPA> for n students (say n=5, 20, etc).
 2. Perform INORDER Traversal of the above tree. Weightage : 5%

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Course: CS UC341 Data Structures and Algorithms
Laboratory Assignment
Faculty : Dr. B. Vijayakumar

Evaluation: DEMONSTRATION ON 30/10/2003

LAB record should be maintained

Record should contain: Algorithm, Program Listing, and Output Results

Record submission date: 3/11/03

1. Write an Algorithm and C/C++ program to perform the following:
 - d) READ in an array of N integer values.
 - e) Use QUICKSORT to sort the input array.
 - f) Display the sorted list Weightage : 5%
2. Write an algorithm and C/C++ program for the following problem:
 3. Create a Binary Search Tree to store <IDNo, Name, CGPA> for n students (say n=5, 20, etc).
 4. Perform INORDER Traversal of the above tree. Weightage : 5%

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Course: CS UC341 Data Structures and Algorithms
Laboratory Assignment
Faculty : Dr. B. Vijayakumar

Evaluation: DEMONSTRATION and VIVA

[Correctness/Modularity/Readability/VIVA: 5 Marks] ON 11/12/2003
Thursday

LAB record should be maintained

Record should contain: Algorithm, Program Listing, and Output
Results [Algorithm: 2.5 marks Program Listing and output: 2.5
marks]

Record submission date: 14/12/03

3. Write an Algorithm and **C/C++ program** to find the minimum
number of multiplications needed for the Matrix Chain-Product
using Dynamic Programming.

Test Cases:	INPUT	OUTPUT
1.	2, 10, 50, 20 [i.e., d0, d1, d2, d3 values]	3000
2.	2, 2, 3, 4, 5 [i.e., d0, d1, d2, d3, d4 values]	76

WEIGHTAGE: 5%
