BITS, Pilani – Dubai Campus, Knowledge Village, Dubai.
IIIYear First Semester 2004-2005
Degree: B.E. Hons. Branch: C.S.E.

TEST I Question Paper

Course No : CS UC341 Course Title: Data Structures & Algorithms
Date: 17, Oct., 2004 Sunday Time: 9 a.m.- 9.50 a.m. Total marks: 20
Data provided are complete. ***Closed Book***.

Answer all questions

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

   A = [47, 23, 84, 11, 65, 58, 92, 36, 99, 87]

   (Note: algorithm **not** required). [5]

2. What is the **average-case** time complexity of each of the following problems?
   a) MERGESORT b) QUICKSORT. [1]

3. Write an **algorithm** to perform **PUSH** operation on a **STACK** as per details given below:

   For PUSH operation, insert the following information for N students [say N=5]:

   <Name of the Student, BirthDay, GroupName>

   Here birthday is a 2 digit field and the values are in the range 01 to 31 [assume correct input]. You will read **input** for *name of the student* and *birthday*. The **GroupName** is calculated as follows:

   - Find **BirthDay MOD 10**. i.e. Divide BirthDay by 10 and take the remainder.
   - Look at the following table to find the **GroupName** of the student:

remainder	GroupName
0	AGATE
1	CORAL
2	DIAMOND
3	EMERALD
4	LAPIS
5	PEARL
6	RUBY
7	SAPHIRE
8	TOPAZ
9	OPAL

 PTO

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[5]

4. ORDER the following functions by GROWTH RATE:

(n^2), $(\log n)$, (2^n), $(n \log n)$ [1]

5. Write a Recursive Algorithm for computing the **depth** of a **node v** in a tree **T**. [2]

6. Write an algorithm to read a positive integer in Decimal System (Base 10) and convert it into its equivalent number in Octal System (Base 8) and display the result..

Example: INPUT:504 in decimal system
OUTPUT: 770 in octal system. [4]

7.

a) In a Binary Search Tree, what is the running time of each of the following methods? i) **findElement** ii) **isEmpty** [1]

b) What is the *purpose* of the method **elemAtRank(r)** in Vector abstract data type? (assume that the Vector **S** stores **n** elements)
[1]

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III Year First Semester 2004-2005

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TEST II Question Paper

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

Date: 05, Dec., 2004 Time: 9.30 am – 10.20 am Total marks: 20

Data provided are complete. **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 = [30, 57, 28, 93, 64] (5 marks)

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

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

Draw the Graph G. [2 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.. The dimensions of the Matrices are given as follows:

   $A_0 = (3x4)$ $A_1 = (4x6)$ $A_2 = (6x4)$ $A_3 = (4x3)$

4. Solve the following instance of fractional Knapsack Problem using Greedy Method: (5 marks)

   $n = 3$, $W = 40$

   $(b_1, b_2, b_3) = \{24, 32, 28\}$ and $(w_1, w_2, w_3) = \{23, 10, 15\}$.

   You will have to compute (x_1, x_2, x_3), Total Benefit earned and total weight of all chosen objects. (4 marks)

5. It is required to insert the following three strings in a HASH Table:
   BATSMAN, KING, KNIGHT.
   The hash function is defined as follows:

   "*Add* the **ASCII values** of individual letters in a *given input string* [ASCII value of 'A' is 65 and so on] and find the **sum**.
   Hash Value = (12 * sum) % 10 . [% means modulus]". This hash value will be the position at which the input string will be inserted.
   Draw the Hash Table and show its contents. [4 Marks]

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BITS, Pilani – Dubai Campus, Knowledge Village, Dubai.

III Year First Semester 2004-2005

Degree: B.E.(Hons.) Branch: C.S.

Comprehensive Examination Question Paper

Course No : CSUC341 Course Title: Data Structures and Algorithms

Date: 06, Jan., 2004 Thursday Time: 10 a.m.- 1 Noon Total marks: 60

Data provided are complete. ***Closed Book***. Question paper has 2 pages.

Answer **all** Questions

1. **Write** an *algorithm* to implement MERGESORT and **Analyze** its Worst-Case Time Complexity. [6 + 3 marks]

2. a) *Write* an **Algorithm** for the HANGMAN problem stated as follows:
Two players A and B proceed to play the word guessing game HANGMAN. Player A thinks of an English Word [assume that the length of the word does not exceed 15 characters]. Now, Player B proceeds to guess the word thought over by Player A by typing one letter at a time. The number of chances given to player B is equal to number of unique letters present in the word plus three.

If Player B guesses a letter correctly, it is displayed at all appropriate position(s) within the word, and the number of chances is decremented by 1. If the Player B guesses a letter wrongly, then display an error message, decrement the number of *chances* by 1 and increment the number of *errors* by 1. If the Player B guesses an already chosen letter (chosen earlier in previous attempts), display the message "you already guessed that" and the counts for *chances* and *errors* remain unchanged. The games ends when the player B guesses the word in the given number of chances or when the player B is unable to guess the word. In either case, *display* appropriate message and show the counts for *chances* and *errors*. [6 marks]

b) Write an algorithm for removing an element **e** stored at position **p** in a doubly linked list. [3 marks]

3.a) Explain the following cases for SPLAY Trees with an example for each:
i) ZIG – ZIG ii) ZIG – ZAG [2.5+3.5 marks]

b) Define the following terms:
i) Reducibility ii) CNF-SAT iii) Class NP. [3 marks]

4.
a) The following character string is to be transmitted using HUFFMAN CODING:

MULTIMEDIAMEDIUMMUDDIMAIMTIMELIMEXLAV

Construct the HUFFMAN Coding Tree step by step for the letters present in the above string and *determine* the number of bits required to code each letter. [5M]

b) Explain Single Right Rotation (SRR) and Single Left Rotation (SLR) operations in an AVL Tree. [2+2 marks]

Course file:

B. Vijayakumar

5. a) Consider the Adjacency Matrix for a weighted, directed graph G shown below:

	A	B	C
A	0	8	5
B	6	0	7
C	13	11	0

Here A, B, C represent vertices(nodes). The weights correspond to distances between pairs of nodes.

i) Draw the Graph G. [1 Mark]

ii) Using the principle of Floyd-Warshall Algorithm, compute ALL-PAIRS SHORTEST PATH DISTANCES. Note: Algorithm not required. [4 marks] .

b) The Task Scheduling Problem is to Schedule all the tasks in T (T is a set of **n** tasks such that each task **i** has **start-time** and a **finish-time**. Start-time < finish-time) on the fewest possible machines possible in a nonconflicting way. Write a GREEDY ALGORITHM for the above problem. [4 marks]

6. a) State the LCS (Longest Common Subsequence) Problem. Give an example. [2 marks]

b) What is the average-case time complexities for QUICKSORT and HEAPSORT? [1 marks]

c) What is a Minimum Spanning Tree? [1 mark]

d) What is a Compressed Trie? Give an example. [2 marks]

e) Define Compression Map. [1 marks]

f) Fill in the blanks:

Let T be a (proper) binary tree with **n** nodes, and let **h** denote the height of T. Then, the height of T is at least _____ and At most _____. [1 mark]

g) Define the operation: **above(p)** in a SKIP-LIST. [1 mark]

7. a) Show the successive steps for INSERTION of the following keys into a 2-4 Tree: 12, 6, 15, 4, 10, 5, 3, 8, 1, 11, 7, 2 [algorithm not required]. [3 marks]

b) Mention an application in computer science that makes use of a circular queue. [1 mark]

c) Insert the following integer keys in a Binary Search Tree: 10, -6, 23, -12, 15, -10, 12 [2 marks]