Bangladesh Army University of Science and Technology

Department of Computer Science and Engineering

Final Examination, Fall 2018 | **Level-2** **Term-I**
Course Code: CSE 2103 | **Course Title: Data Structures**
Time: 03 (Three) hours | **Full Marks: 210**

N.B. (i) Answer any three questions from each PART (ii) Use separate answer script for each PART
(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)---------N/A----------

PART A

(Answer any three questions)

1. a) What is a data structure? When is a data structure called a linear data structure? Write the properties of a linear data structure. 2+2+3=7

   b) Given a singly linked list with Head pointer and an integer N, write a function deleteFromLast(N, Head) that deletes last N number of nodes from the given linked list. 6

   c) Why is an array called a random access data structure? Let A and B be two sorted arrays of integers. Write an algorithm to make a sorted array of integers C by merging the arrays A and B. 4 +10=14

   d) What is a proper binary tree? Construct the proper binary tree whose inorder and postorder traversals are given as: 2+6=8

   Inorder: BAUSTcse123

   Postorder: BUATscS132e

2. a) How do you implement a Queue using a Stack? What are the running time of enqueue and dequeue operations of such implementation? 5+5=10

   b) What is recursion? Let J and K be integers and suppose Q(J, K) is recursively defined by, 2+9=11

$$Q(J, K) = \begin{cases} 5 & \text{if } J<K \\ Q(J-K, K+2)+J & \text{if } J>=K \end{cases}$$

   Find the Q(2, 7), Q(5, 3) and Q(15, 2).

   c) Differentiate between stack and queue. What are the advantages of two way linked list over one way linked list? 4+5=9

   d) Write down the merits and demerits of a linked list over an array data structure. 5

3. a) Suppose we create a binary search tree by inserting the following values in the given order: 50, 10, 13, 45, 55, 110, 5, 31, 64, and 47. Answer the following questions: 3×4=12

   i) Draw the binary search tree.

   ii) Show the output values if we visit the tree using pre-order traversal technique.

   iii) Show the output values if we visit the tree using post-order traversal technique.

   iv) Show the resulting trees after we delete 47, 110, and 50. (Each deletion is applied on the original tree.)

   b) Consider the following arithmetic infix expression : 7+5=12

   Q: 21+ (4 * 6– (16/2^3) *12) * 100

   Convert this into a postfix expression by showing the status of the stack after scanning each symbol. Then evaluate the value of the derived expression using stack.

   c) Create a linked list of the array A= {100, 200, 300, 400}. Mention the steps to insert 600 at the starting of a singly linked list. Then delete the last item and traverse the linked list. 4+7=11

4. a) How do you implement a dictionary by using a 'Hash Table' data structure? Write three applications of a dictionary. 3+3=6

b) Draw the hash table that results from using the hash function $h(k) = (2k + 7) \bmod 11$ to hash the keys 17, 33, 13, 88, 43, 64, 11, and 25, assuming collisions are handled by chained linked-lists. Show detailed calculations. 12

c) Consider an open-addressing hash table as shown below. The table already contains four data items, and other empty slots contain NIL. Assume that collisions are handled by Quadratic probing using the hash function $h(k, i) = (\mathbf{h'(k)} + i^2) \bmod 13$, where $\mathbf{h'(k)} = (k + 7) \bmod 13$. By showing detailed calculations, redraw the table after 17
(i) insert 47; (ii) insert 64; (iii) delete 12 (replacement with NIL); (iv) search 38.

0	1	2	3	4	5	6	7	8	9	10	11	12
70						12	38					44

PART B
(Answer any three questions)

5. a) Why is Quick Sort preferred over Merge Sort for sorting array and vice versa? 6

b) Define a Heap. Build a Max Heap using the following data and perform the operations. 4+(2×4) =12
Data: 44, 33, 11, 55, 77, 90, 40, 60, 99, 22, 88, 66.
i) Delete 99
ii) Insert 111
iii) Delete 88
iv) Sort the mentioned data using Heap Sort algorithm

c) Given two strings, S_1= "baustcserocks" and S_2= "cserocks". Discuss a dynamic programing approach to find the longest common substring. 7

d) Write the Brute-Force string matching algorithm. And derive its complexity. 7+3=10

6. a) Draw the appropriate tree diagram to solve the Tower Hanoi problem with 4 disks. And write the pseudo code to solve the problem. 5+6=11

b) Consider the directed graph shown in Figure-6(b) and answer the following questions: 7+7=14

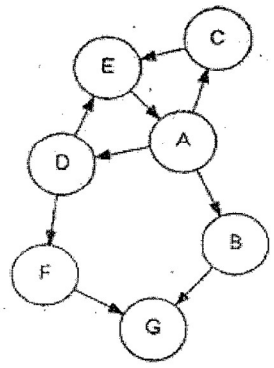

Figure-6(b)

i) Perform depth first search on the graph starting from vertex A. Choose the smallest (in alphabetical order) vertex when there is a choice. Find the discovery time and finishing time of each vertex.

ii) Perform breadth first search on the graph starting from vertex A. Choose the smallest (in alphabetical order) vertex when there is a choice. Find the distance and parent of each vertex.

c) What is Sparse Matrix? Derive the triplet representation of the following array: array[4][3]={{0,2,3},{1,0,0},{0,0,0},{2,0,0}}. 3+7=10

7. a) What are the basic conditions for topological-sort? State the algorithm. Find out the topological order of the following graph of Figure-7(a). 5+7+7=19

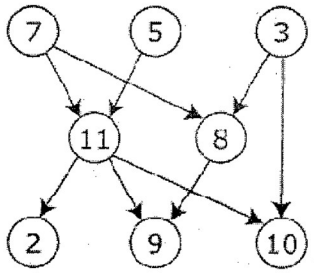

Figure-7(a)

b) Find out the shortest path for the following graph of Figure-7(b) by applying modified Floyd-Warshall algorithm. 8

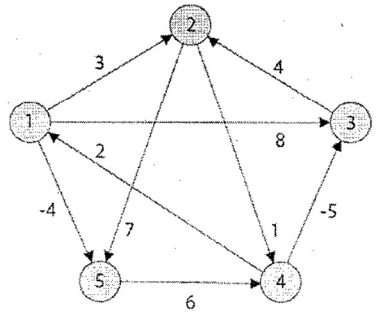

Figure-7(b)

c) Generate Huffman Tree by using Huffman coding algorithm for the following data table. 8

Value:	A	B	C	D	E	F
Frequency:	5	25	7	15	4	12

8. a) What is a Max-heap? Draw a complete binary tree using the numbers 35, 26, 43, 25, 50, 12, 75, 32, 48, 30, 37. Then redraw the tree (by showing necessary steps) so that it satisfies the Max-heap property. 10

b) Write the Selection Sort algorithm. Analyze the worst-case time complexity of the Selection Sort algorithm. How many exchanges of data are done in the Selection Sort algorithm for an array of size n? 6+6+3=15

c) Briefly explain how probe sequences are generated by Linear Probing, Quadratic Probing, and Double Hashing techniques of open addressing. 10