University of Rajshahi
Department of Computer Science and Engineering
B. Sc. Engg. Part 2 Odd Semester, Examination-2021
Course: CSE-2121 (Data Structure)

Full Marks: 52.5 **Duration: 3Hours**

[Answer six questions taking any three from each section]

Section A

1. (a) What is the benefit of binary search over linear search? 2
   (b) Maze (1:6, -4:1, 5:10) is a 3D array with base=100, w=4, calculate Maze [3, -2, 8] address in a row major order and column major order. 3.75
   (c) We often store sparse matrix in a 1D array to save spaces. What is the memory saving if we store a sparse matrix in a 1D array rather than a 2D array? 3

2. (a) What is a linked list? Explain the main differences between the linked list and linear array? 2.75
   (b) Briefly discuss the terms garbage collection, overflow and underflow. 3
   (c) One of the advantages of linked list is the ability to insert data into the list easily. Explain with your own words and figures how to insert data at the beginning, after a given node, at the end and to a sorted list. 3

3. (a) Define stack. Explain the usage of stack in recursive algorithm implementation. 3
   (b) Simulate the infix to postfix transformation algorithm for
   Q: A + (B * C - (D / E ↑ F) * G) * H by showing the stack's contents as each element is scanned. 3.25
   (c) Write down a routine to insert an element onto a queue. 2.5

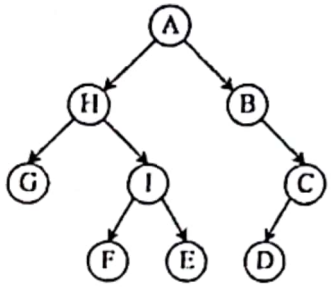
4. (a) What is a hash function? 2
   (b) The keys 14, 12, 18, 13, 2, 3, 23, 5 and 15 are inserted into an initially empty hash table of length 10 using open addressing with hash function h(k) = k mod 10 and plus 3 probing. What is the resultant hash table? 3
   (c) A hash table of length 10 uses open addressing with hash function h(k)=k mod 10, and linear probing. After inserting 6 values into an empty hash table, the table is as shown below. 3.75

		42	23	34	52	46	33		
0	1	2	3	4	5	6	7	8	9

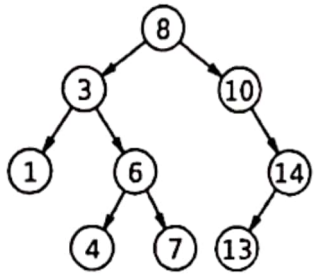
Which one of the following choices gives a possible order in which the key values could have been inserted in the table?
(A) 46, 42, 34, 52, 23, 33
(B) 34, 42, 23, 52, 33, 46
(C) 46, 34, 42, 23, 52, 33
(D) 42, 46, 33, 23, 34, 52

Section B

5. (a) Define the terms (i) siblings, (ii) ancestor, and (iii) depth of a binary tree. 3
   (b) Tree traversal (also known as walking the tree) refers to the process of visiting each node exactly once. Simulate the preorder traversal algorithm for the following tree. 5.75



6. (a) What is adjacency matrix? How is it formed? 2.75
   (b) Define the terms (i) Isolated node, (ii) Simple Path and (iii) Weighted Graph. 3
   (c) How can you search '5' in the following binary search tree? However if '5' is not in the tree just insert to its appropriate place and show the resultant tree. 3



7. (a) What is meant strongly and weakly connected in a graph? 2
   (b) Prove that the maximum number of edges that a graph with **n** vertices is **n*(n-1)/2**. 2.75
   (c) Explain Breadth First search algorithm with example. 4

8. (a) Suppose we want to encode a message constructed from the symbols A, B, C, D, E, F and G using a fixed-length code. How many bits are required to encode the message FDEGAACAAGAAFABA? 2
   (b) Build the Huffman coding tree for the message 'science engineering'. 3.75
   (c) Suppose you are to insert a node 'X' as the right child of node 'P'. Discuss the inserting mechanisms with figures. 3
      i. When the right subtree of 'P' is empty.
      ii. When the right subtree of 'P' is not empty.

University of Rajshahi
Department of Computer Science and Engineering
B. Sc. (Engg.) Part-2 Odd Semester Examination-2017
Course: CSE-2121 (Data Structure)
Full Marks: 52.5 Time: 3:00 Hours

[N.B. Answer any SIX questions taking THREE questions from each part]

Part-A

1. a) What is linear array? How can you find the no. of elements in any linear array? 2
   b) Simulate the binary search algorithm on the following data: 11 22 33 44 55 66 77 88 99 110 121 132 143 (suppose we search for item 120). 3.75
   c) What is 2D array? How can you represent 2D array in memory? 3

2. a) Room (1:8, -4:1, 6:10) is a 3D array with base=400, w=2, calculate Room [4, -2, 7] address in a row major order and column major order. 3
   b) What is sparse matrix? How can you locate element a_{ij} of a sparse matrix from a 1D array? 2.75
   c) What is memory saving if we store a sparse matrix in a 1D array rather than a 2D array? 3

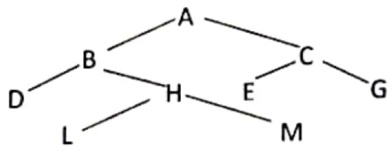
3. a) What is a Linked List? Discuss with example. 1
   b) Define overflow and underflow? How can you handle them? 1.75
   c) Briefly discuss inserting mechanism of an item at the beginning, after a given node, at the end and to a sorted list. 5
   d) What is Header Linked List? 1

4. a) Differentiate between stack and queue. 1.75
   b) Convert the following infix expression to its equivalent prefix and postfix expression . 4
      (i) A+(B-C)*D/E+F/G↑H
      (ii) (1+2)*3-4/5*6↑7
   c) Simulate the postfix expression evaluation algorithm using 20, 5, 2, *, /, 2, 3, ↑, ↑, 4, /, - by showing Stack's contents as each element is scanned. 3

Part-B

5. a) What is complete binary tree? A complete binary tree has1129 nodes, find out the depth of the tree. 2
   b) Discuss the linked representation of binary tree in memory. 2.75
   c) Simulate the maxheap algorithm for the following values: 67, 29, 90, 48, 12, 34, 90, 9, and 12. 4

6. a) Illustrate similar and copies with example. 2
   b) What is an extended tree? 1
   c) Simulate the postorder traversal algorithm for the following tree. 5.75



7. a) Define the following terms: Connected Graph, Path, and Weighted Graph. 3
   b) How many ways a graph G can be traversed? What is the significance of the STATUS field? 2
   c) Consider the adjacency list of the Graph G in the following table. Draw the graph and find out the path from A to F with minimum number of nodes along that path using Breadth First Search. 3.75

Node	Adjacency	Node	Adjacency
A	E, G	E	H
B	C	F	A, B
C	F	G	B, C, E
D	C	H	D

8. a) Define deque and priority queue with example. 2
   b) Write the steps of preorder and postorder traversal of a binary tree. 4
   c) What is binary search tree? Mention the advantages of a binary search tree. 2.75

University of Rajshahi

Department of Computer Science and Engineering

B. Sc. (Engg.) Part-2 Odd Semester Examination-2016

Course: CSE 2121 (Data Structure)

Full Marks: 52.5 Duration: 3(Three) Hours

Answer 06(Six) questions taking any 03(Three) questions from each part

Part-A

1. (a) Define data structure. Why is data structure necessary? 3
   (b) What do you mean by Linear data structure and Nonlinear data structure? Give example. 2.75
   (c) What is sparse matrix? What is the difference between triangular matrix and Tridiagonal matrix? 3

2. (a) What are the advantages of Linked List? 4
   (b) Suppose 10 elements are maintained by array and another 10 are by Linked List. Which methods take longer time to access 7^{th} element. Justify your answer. 2
   (c) What is two way lists? Why is it important? Explain with schematic diagram. 2.75

3. (a) Discuss the array representation mechanism of stack. 3
   (b) What is polish notation? What are the benefits of polish notation? 2
   (c) Convert the following infix expression to its equivalent prefix and postfix expression. 3.75
   (i) A*B/C+D↑(E-F*G)/H
   (ii) 1+2*3/4↑5*6-7*8

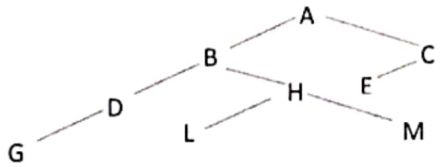
4. (a) Simulate the postfix expression evaluation algorithm using 12, 6, /, 6, 2, +, *, 12, 4, /, - by showing Stack's contents as each element is scanned. 3

   (b) What is recursion? Explain the use of recursion. 3
   (c) Explain the operations on queue with example. 2.75

Part-B

5. (a) Briefly discuss inserting and deleting mechanism of an item in the linked list. 4.75
   (b) Define deque and priority queue with example. 2
   (c) What is garbage collection? When does it take place? 2

6. (a) Simulate the preorder traversal algorithm for the following tree. 5



   (b) What is binary search tree? Why binary search tree is important? 2
   (c) What is the difference between maxheap and minheap? 1.75

7. (a) Define weighted graph and directed graph with example. 2.75

(b) Consider the following adjacency matrix below: 3

$$A = \begin{pmatrix} 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 \end{pmatrix}$$

Now find out A2, A3, A4, B4 and from that make the path matrix and tell whether this is strongly connected or not.

(c) Use the Warshall's algorithm to find the shortest path matrix of the weighted matrix given below. 3

$$W = \begin{pmatrix} 6 & 8 & 0 & 0 \\ 3 & 0 & 0 & 9 \\ 5 & 8 & 3 & 6 \\ 6 & 2 & 3 & 0 \end{pmatrix}$$

8. (a) Discuss the sequential representation of Graph with example. 4

(b) Consider the adjacency list of the Graph G in the following table. Find the nodes that are reachable from node C using Depth First Search. 4.75

Node	Adjacency	Node	Adjacency
A	G, E	E	C
B	C	F	A, B
C	F	G	B, C, E
D	C	H	D

University of Rajshahi
Department of Computer Science and Engineering
B. Sc.(Engg.) Part2 Odd Semester, Examination-2015
Course: CSE-2121 (Data Structure)

Full Marks: 52.5 **Time: 3Hours**

[N.B.: Answer any Six (06) Questions taking at least Three (03) from each part.]

Part -A

1. a) Why data structure is needed? Differentiate between linear and nonlinear data structure. 3
   b) Explain linear array representation in memory. 2
   c) Simulate the binary search algorithm on the following data: 10, 20, 50, 70, 80, 90, 100, 110 (suppose we search for item 110). 3.75

2. a) For column major order find out the address of the element score [15,3] from a 20X5 matrix array score with base value 100 and w=4. 3
   b) How does a pointer array can save memory when stores a variable sized group of data? Discuss with necessary figures. 3.75
   c) What is a record? What is the difference between a record and a linear array? 2

3. (a) Explain the representation of linked lists in memory. 3
   (b) Discuss header linked list. Describe grounded and circular header list. 3
   (c) Briefly explain two-way linked list. 2.75

4. a) What is stack? What are the operations on stack? Explain with example. 3
   b) Convert the following infix expression to its equivalent prefix and postfix expression 3.75
      (i). A+B*C/D-E+(F/G+H↑K)
      (ii). (1+2) ↑3/4*5+7-8↑9
   c) What is priority queue? Why is it important? 2

Part-B

5. a) Illustrate similar and copies of a tree with examples. 3
   b) What is complete binary tree? What is the parent-child relationship? 2
   c) For the expression: ***+a-bc*-de-/fgh** draw the tree and perform inorder and postorder traversal. 3.75

6. (a) What is binary search tree? 1.75
   (b) Suppose the following six numbers are inserted into an empty binary search tree: 33, 50, 45, 52, 12, 10. Show the tree as each number is inserted into a binary search tree. 4
   (c) Simulate the maxheap algorithm for the following values: 77, 40, 90, 65, 20, 35, 95, 10, 15. 3

7. a) Define the following terms: (i) Degree of a node, (ii) Isolated node, (iii) Path, (iv) Multi Graph. 3.75
   b) Consider the following adjacency matrix below: 5

$$A = \begin{pmatrix} 0 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 1 \end{pmatrix}$$

   Now find out A2, A3, A4, B4 and from that make the path matrix and tell whether this graph is strongly connected or not.

8. a) Discuss the linked representation of Graph with example. 3.75
   b) Consider the adjacency list of the Graph G in the following table. Draw the graph and find out the path from A to H with minimum number of nodes along that path using Breadth First Search. 5

Node	Adjacency	Node	Adjacency
A	E,G	E	H
B	C	F	A, B
C	F	G	B, C, E
D	C	H	D

University of Rajshahi
Department of Computer Science and Engineering
B. Sc. Engg. Part-II Odd Semester, Examination-2014
Course: CSE-2121 (Data Structure)

Full Marks: 52.5 Time: 3 Hours

Answer **six (06)** questions taking **three (03)** from each part

Part A

1. a) What is data structure? What are the differences between linear and nonlinear data structure? 2.5
   b) Explain the depth-first search technique. 3.5
   c) What do you mean by internal and external sorting? List some names of each type. 2.75

2. a) What is a linked List? Discuss with example. 2
   b) Suppose 20 elements are maintained by array and another 10 are by Linked List. Which method will take longer time to access 9^{th} element? Justify your answer. 2
   c) Briefly discuss inserting mechanism of an item at the beginning, after a given node and at the end. 4.75

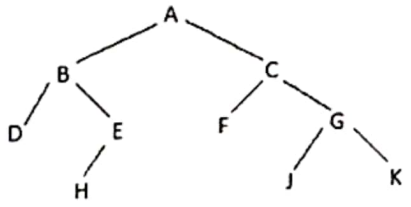
3. a) What is polish notation? What are the benefits of polish notation? 2
   b) Convert the following infix expression to its equivalent prefix and postfix expression: 4
      (i) A*B+(C*D/E)*F+(G↑H)
      (ii) 1*2/3+(4-5↑6)+7-8
   c) Simulate the postfix expression evaluation algorithm using 12, 6, /, 6, 2, +, *, 12, 4, /, - by showing Stack's contents as each element is scanned. 2.75

4. a) What is overflow and underflow? How can you handle them? 3.25
   b) What is a two way list? Why is it important? Explain with schematic diagram. 3.5
   c) What is garbage collection and compaction? 2

Part B

5. a) For column major order find out the address of the element marks[12,3] from a 25X4 matrix array marks with base value 250 and w=8. 2
   b) What is pointer and pointer array? 1.75
   c) How a pointer can save memory space to store a 2D array? 3
   d) What is the difference between Triangular matrix and Tridiagonal matrix? 2

6. a) Define heap, leaf and depth of tree. For 5009 nodes, find out the depth of the tree. 3.75
   b) Discuss the linked representation of binary tree in memory. 2
   c) Simulate the preorder traversal algorithm for the following tree 3



7. a) Define the following graph terms: (i) Adjacent Nodes, (ii) Cycle, (iii) Connected graph, and (iv) Weighted graph. 2
   b) Discuss the sequential Representation of Graph with example. 2.75
   c) Consider the following adjacency matrix below: 4

$$A = \begin{pmatrix} 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 \end{pmatrix}$$

Now find out A^2, A^3, A^4, B_4 and from that make the path matrix and tell whether this is strongly connected or not.

8. a) What is Directed Graph? Explain. 2
b) How many ways a graph G can be traversed? What is the significance of the STATUS field? 1.75
c) Consider the adjacency list of the Graph G in the following table. Find the nodes that are reachable from node C using Depth First Search. 5

Node	Adjacency	Node	Adjacency
A	G, E	E	C
B	C	F	A, B
C	F	G	B, C, E
D	C	H	D

University of Rajshahi

Department of Computer Science and Engineering

B.Sc. Engg. 2nd Year 1st Semester Examination-2012

Course: CSE2111 (Data Structure)

Time: 4 Hrs. **Full Marks:** 52.5

[N.B. Answer any ***three*** questions from each part.]

Part-A

1. a) What is data structure? Differentiate between linear and nonlinear data structure. 3

   b) What are the advantages of binary search over linear search? $1\frac{3}{4}$

   c) Suppose you are searching for the location of item 220. Simulate binary search on the following data set: 2,5,7,9,10,12,100,102,119,220,220,234 and 540. 4

2. a) Suppose 21 elements are maintained by an array and another 21 are by a linked list. Which method takes longer time to access 17th element. Justify your answer. 2

   b) What is overflow and underflow? How can you handle them? 2

   c) Briefly discuss inserting mechanism of an item at the beginning, after a given node and at the end. 2

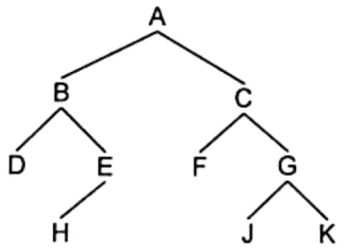
   d) What is two way list? Why it is important? Explain with schematic diagram. $2\frac{3}{4}$

3. a) Define the following terms of a tree: siblings, successors, ancestors and level. 2

   b) What is meant by depth of a tree? For 5009 nodes, find out the depth of the tree. 2

   c) Discuss the linked representation of binary tree in memory. $1\frac{3}{4}$

   d) Simulate the preorder traversal algorithm for the following tree. 3



4. a) Define hash collision, rehashing and Hash Chaining. $2\frac{3}{4}$

   b) Differentiate between static and dynamic hashing. 3

   c) Briefly describe various hash functions. 3

Part-B

5. a) Suppose a multidimensional array A and B are declared using A[2:9, 7:20,4:40], B[1:3,-3:10,2:23]. Find the length of each dimension and the number of elements in A and B. Find the memory location of B[2,4,3] assuming Base(B)=FF01 and word size is 2 Bytes. $3\frac{3}{4}$

   b) What is polish notation? Why polish notation is used? 2

   c) Transform each of the following expression 3
   i) 5 * (3 + 4) - (2 * (2 + 2 * (1 + 2))) →to postfix
   ii) 3, 4, +, 9, 3, 4, *, 2, +, -, * → evaluate the value of this expression.
   iii) - , / , + , A , ↑ , B , D , - , E , F , G → to infix.

6. a) What is directed graph? Explain. 2
   b) How many ways a graph G can be traversed? What is the significance of the STATUS field? $1\frac{3}{4}$
   c) Briefly discuss hash table. 2
   d) Using Warshall's algorithm, find the shortest path matrix of the weighted matrix given below. 3

$$W=\begin{pmatrix}6 & 0 & 0 & 0\\ 3 & 0 & 0 & 9\\ 5 & 8 & 3 & 6\\ 6 & 2 & 3 & 0\end{pmatrix}$$

7. a) Define the following terms: graph, neighbor, closed path, complete graph and weighted graph. $2\frac{3}{4}$
   b) Discuss the linked representation of graph with example. 3
   c) Consider the following adjacency matrix in following figure and find out A^2, A^3, A^4 and B_4 and make path matrix and tell whether this is strongly connected or not. 3

$$A=\begin{pmatrix}1 & 0 & 1 & 0\\ 0 & 1 & 0 & 1\\ 0 & 0 & 1 & 0\\ 1 & 1 & 0 & 1\end{pmatrix}$$

8. a) Transform E=((D + E) / -A) * (G ^ B) to extended binary tree then find the pre order and post order traverse of that tree. $2\frac{3}{4}$
   b) What is Heap? 1
   c) Construct a heap step by step from the following data (3, 4, 7, 8, 10, 19, 20, 21, 22, 25, 28). Insert a new item 6 in to the heap then rebuild the heap. Delete the element 8 and then rebuild the heap. 5