Siliguri Institute Of Technology

Department of Computer Science & Engineering

DATA STRUCTURE AND ALGORITHM

PCC-CS301 & PCC-CS391

2020-21

Course Description File on Data structure and Algorithm
2nd YEAR, 1st Semester

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

[redacted]

To be a recognized institution offering high quality education, opportunities to students to become globally employable Engineers/Professionals in best ranked industries and research organization.

[redacted]

To impart quality technical education for holistic development of students who will fulfill the needs of the industry/society and be actively engaged in making a successful career in industry/research/higher education in India & abroad.

[redacted]

To be a nationwide recognized department that produces versatile computer engineers, capable of adapting to the changing needs of computer and related industry.

[redacted]

To impart quality technical education with skills, knowledge and attitude to succeed in Computer Science & Engineering careers.
To provide knowledge of emerging trends in computer and related industry and foster environment of lifelong learning.

To develop graduate engineers who investigate research, design and find workable solutions to complex engineering problems with awareness and concern for society and environment.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities

and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

1. **PSO1:** Apply probability, statistics, mathematics through differential and integral calculus, sciences including applications appropriate to the Computer Science & Engineering topics.

2. **PSO2:** Use algorithms, data structures/management, software design, concepts of programming languages and computer organization & architecture.

The graduates of Computer Science & Engineering will:

1. Competent professionals with knowledge of Computer Science & Engineering to pursue variety of careers/higher education.
2. Proficient in successfully designing innovative solutions to real life problems that are technically sound, economically viable and socially acceptable.
3. Efficient team leaders, effective communicators and capable of working in multi-disciplinary environment following ethical values.

4. Capable of adapting to new technologies and constantly upgrade their skills with an attitude towards lifelong learning.

Course Title: DATA STRUCTURE AND ALGORITHM

Code: PCC-CS301 & PCC-CS391

YEAR: 2ND

Semester: 1ST SEMESTER

Name of the Faculty: Prof. Sutapa Bhattacharya

Internet Homepage: https://sites.google.com/view/sutapabhattacharya/home

E-mail: sutapa2007@gmail.com

Phone No: 9474764215

Class Schedule

Dept./Day	Monday	Wednesday	Thursday	Friday
CSE(B)	10:50AM–11:40AM	12:30PM-1:20PM	-------	3:50PM-4:40PM

Lab Schedule

Hours for meeting students:

Monday	14.10 -15.00 pm
Tuesday	14.10 -15.00 pm
Friday	14.10 -15.00 pm
Or by appointment	

i) Course Objective

Students will be capable to demonstrate the basic concept of data structures and implement it through C programming language and compute asymptotic notations of an algorithm to analyze the consumption of resources (time/space).

ii) Course Outcomes

i. After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

The student will be able to:

		Target
PCC-CS301 .1	**Describe** concepts of data structures, pseudo-code and define asymptotic notations to analyze the performance of algorithms. **(BT-LEVEL 2)**	Students will attain 60% marks
PCC-CS301 .2	**Implement** various operations onarray and linked list data structures. **(BT-LEVEL 3)**	Students will attain 60% marks
PCC-CS301 .3	**Solve** different problems involving stack and queue data structures as well as problems of recursive nature. **(BT-LEVEL 3)**	Students will attain 60% marks
PCC-CS301 .4	**Utilize** the knowledge of non-linear data structures like trees and graphs to design algorithms for various applications .**(BT-LEVEL 3)**	Students will attain 60% marks
PCC-CS301 .5	**Verify** various algorithms for Sorting, Searching and Hashing. **(BT-LEVEL 5)**	Students will attain 60% marks

ii. Once the student has successfully complete this course, he/she must be able to answer the following questions or perform/demonstrate the following:

SN	QUESTION	CO
1.	**Define** linear and non-linear data structure.	1
2.	**Describe** briefly about asymptotic notations.	1
3.	How do you **implement** the linked list data structure?	2
4.	How to **solve** the problem of singly linked list?	2
5.	How do you **implement** stack using array and linked list?	3
6.	How do you **implement linear** queue using array and linked list?	3
7.	How do you **implement** linear queue using array and linked list?	3
8.	How to **calculate** Balance factor in AVL tree?	4
9.	How can implement a non-linear data structure?	4
10.	What is the technique to **detect** worst time complexity in quick sort?	5
11.	How to **verify** complexity of sorting algorithm**?**	5

iii) Topic/Unit/Chapter Layout

SN	Unit Mapping	CONTENT	Lecture Required
1	**Unit-I**	**Introduction(2L)** Why we need data structure? Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type. Algorithms and programs, basic idea of pseudo-code. Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.	2
2	**Unit-II**	**Array (2L)** Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials.	2
3	**Unit-III**	**Linked List (4L)** Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.	4
4	**Unit-IV**	**Stack and Queue (5L)** Stack and its implementations (using array, using linked list), applications. Queues, circular queue, Priority Queue .Implementation of queue- both linear and circular (using array, using linked list), applications.	5
5	**Unit-V**	**Recursion (2L)** Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi, Eight Queens Puzzle.	2
6	**Unit-VI**	**Nonlinear Data structures Trees (9L)** Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees – operations (insertion, deletion with examples only). B+ Tree: definitions, algorithms and analysis	9
7	**Unit-VII**	**Nonlinear Data structures Trees Graphs (6L)**: Graph definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut-vertex/articulation point, pendant node, clique, complete graph, connected components – strongly connected component, weakly connected component, path, shortest path, isomorphism). Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list. Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge,	6

		back-edge, cross-edge, and forward-edge), applications. Minimal spanning tree – Prim's algorithm (basic idea of greedy methods).	
8	**Unit-VIII**	**Sorting (5L)** Bubble sort and its optimizations, insertion sort, shell sort, selection sort, merge sort, quicksort, heap sort (concept of max heap, application – priority queue), radix sort and their complexity analysis.	5
9	**Unit-IX**	**Searching (2L)** Sequential search, Binary search and their complexity analysis.	2
10	**Unit-X**	**Hashing (3L)** Hashing functions, collision resolution techniques.	3

iv) Text& Reference books

Text Books:

1) Data Structure and Algorithms , Seymour Lipschutz, TMH Publications
2) Data Structures using C and C++ by Langsam, Tenenbaum, PHI publications

Reference Books:

1) "Fundamentals of Data Structures of C" by Ellis Horowitz, SartajSahni, Susan Anderson-freed

2) Data structures through C language by Samiran Chattopadhyay

v) Evaluation Scheme

1) Theory

Evaluation Criteria	Marks
Continuous Assessment	25
Attendance	5
University Exam/External Exam	70
Total	100

* The Internal assessment will be determined through the continuous assessment (CA) which is needed to be submitted 4 times in a semester based on performance of the students assessed as per academic calendar published by the University. The 4 no's of CAs will be based on test/ viva/ quiz/ presentation/seminar/ GD etc. out of which 2 no's preferably would be tests.

Schedule for Continuous Assessment (CA):

CA Description	Schedule
Quiz – 1	As per Institute Academic Calendar
1st Internal Examination	
Quiz – 2	
Assignment	
2nd Internal Examination	

Course target attainment levels:

Attainment Level	Inference	Marks

Attainment Level 1	50% of the students have attained more than the target level of that CO	1
Attainment Level 2	60% of the students have attained more than the target level of that CO	2
Attainment Level 3	70% of the students have attained more than the target level of that CO	3

Course Target for the university examination = 60% of the students will get "A" Grade

Target has been set on the basis of last year's performance / result by the students, student quality this year and difficulty level of the course.

University Grading System:

Grade	Marks
O	90% and above
E	80 – 89.9%
A	70 – 79.9%
B	60 – 69.9%
C	50 – 59.9%
D	40 – 49.9%
F	Below 40%

vi) Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes												PSOs	
	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO1 0	PO1 1	PO12	PSO1	PSO2
PCC-CS30 1.1	1	1	--	--	--	--	--	--	--	--	--	--	1	1
PCC-CS30 1.2	2	2	--	--	2	--	--	--	2	--	--	--	1	1
PCC-CS30 1.3	2	2	--	--	2	--	--	--	2	--	--	1	1	1
PCC-CS30 1.4	2	2	--	--	2	--	--	--	2	--	--	1	--	1
PCC-CS30 1.5	3	3	--	--	2	--	--	--	2	--	--	1	--	1
PCC-CS30 1	**2**	**2**	--	--	**2**	--	**--**	--	**2**	--	--	**1**	**1**	**1**

1 = courses in which the student will be exposed to a topic
2 = courses in which students will gain competency in that area
3= courses in which students will master that skill

(vii) Assessment Methodology

Outcome	Assessment Tool
PCC-CS301.1	Internal Test, Quiz, University Exam, PPT Presentation
PCC-CS301.2	
PCC-CS301.3	
PCC-CS301.4	
PCC-CS301.5	

(VIII)Weekly Lesson Plan

Week	Lectures	Planned Date	Execution Date	Laboratory	Assignment/Quiz
1	Discussion on course outcome and program outcome **Introduction:** Remembering C programming language. Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type.	17/08/2020	17/08/2020	Array	**Assignment1**
	Algorithms and programs, basic idea of pseudo-code. Basic idea of pseudo-code, Algorithm efficiency and analysis **Linear Data Structure: Array-** Insertion, Deletion, Traversing, Row Major, Column Major	19/08/2020	19/08/2020		
	Linear Data Structure: Singly Linked List-Definitions, Operations- Create, Traverse	21/08/2020	21/08/2020		
2	**Singly Linked List**- Insertion ,Deletion Algorithm	24/08/2020	24/08/2020	Singly Linked list	**Assignment1**
	Singly Linked List- Reverse, Traverse(in reverse order),Sorting, Searching Algorithm	26/08/2020	26/08/2020		
	Linear Data Structure: Stack-Definitions, operations (push, pop, traverse). Implementations stack using array and linked list	31/08/2020	31/08/2020		

3	Polish notations Conversion -infix to postfix, Evaluation of postfix	02/09/2020	02/09/2020	Singly Linked list	**Assignment1**
	Principles of recursion – use of stack, differences between recursion and iteration, tail recursion, Applications - The Tower of Hanoi	04/09/2020	04/09/2020		
	Linear queue -(Definition, implementation using array and Linked List)	07/09/2020	07/09/2020		
4	**Circular queue-**(Definition, implementation using array) and Linked List)	09/09/2020	09/09/2020	Stack	**Quiz 1**
	Circular queue-implementation using Linked List	10/09/2020	10/09/2020		
	Priority Queue-- Operations, Algorithms and their analysis.	14/09/2020	14/09/2020		
5	**Nonlinear Data structures- Trees :**Basic terminologies, forest, tree representation (using array and linked list)	20/09/2020	20/09/2020	Linear Queue	**Assignment2**
	Binary trees - binary tree traversal (pre-, in-, post- order)	21/09/2020	21/09/2020		
	Binary search tree-Definition and operations (create, insert, traverse, search)	23/09/2020	23/09/2020		
6	BST Deletion	25/09/2020	25/09/2020	Circular Queue	**Assignment2**
	Expression tree, Threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree	27/09/2020	27/09/2020		
	Height balanced binary tree – AVL tree (insertion, deletion with examples only).	29/09/2020	29/09/2020		

7	Height balanced binary tree – AVL tree (insertion, deletion with examples only)—Continued..	30/09/2020	30/09/2020	Recursion	**Assignment2**
	B- Trees – operations (insertion, deletion with examples only).	05/10/2020	05/10/2020		
	B+- Trees – operations (insertion, deletion with examples only).	07/10/2020	07/10/2020		
8	**Sorting Algorithms :** Bubble sort and its optimizations, Insertion sort and analysis of time complexity	12/10/2020	12/10/2020	BST	**Assignment2**
	Selection sort and analysis of time complexity	02/11/2020	02/11/2020		
	Merge sort and analysis of time complexity	04/11/2020	04/11/2020		
9	Quick sort and analysis of time complexity	09/11/2020	09/11/2020	Sorting	**Quiz 2**
	Heap sort (concept of max heap) and analysis of time complexity	04/12/2020	04/12/2020		
	Shell sort, Radix sort and analysis of time complexity	11/12/2020	11/12/2020		
10	**Searching :** Sequential , Binary search and its time complexity	14/12/2020	14/12/2020	Sorting	**Assignment2**
	Doubly Linked List and its operations	18/12/2020	18/12/2020		
	Circular Linked List and its operations	21/12/2020	21/12/2020		
11	Polynomial and Applications using array and linked list	06/01/2021	06/01/2021	Searching and Double linked list	**Assignment2**

	Non-linear Data structure: Graphs- definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut-vertex/articulation point, pendant node, clique, and complete graph, connected components – strongly connected component, weakly connected component, path, shortest path, isomorphism)	08/01/2021	08/01/2021		
	Graphs: Definitions (Graph representations storage implementations – adjacency matrix, adjacency list, adjacency multi-list.**,** connectivity – Depth-first search (DFS)	13/01/2021	13/01/2021		
12	Breadth-first search (BFS) – concepts of edges used in DFS and BFS, applications.	15/01/2021	15/01/2021	Circular Linked List	**Quiz 2**
	Minimal spanning tree – Prim's algorithm (basic idea of greedy methods).	18/01/2021	18/01/2021		
	Hashing : Hashing functions, collision resolution techniques	20/01/2021	20/01/2021		
13	Eight Queen Puzzle Problem, Sparse Matrix	22/01/2021	22/01/2021	Polynomial Addition ,Multiplication	
	Discussion on Previous Question Paper on WBUT	25/01/2021	25/01/2021		
	Revision Lesson 1	27/01/2021	27/01/2021		
14	Revision Lesson 2	29/01/2021	29/01/2021	Hash table implementation	

B. Daily Lesson Plan (Repeat format for each unit)

UNIT: 1 **Title : <u>Introduction</u>** **Day:1**
CONTENTS 1)Discussion on program outcome ,Introduction to C programming language with example

2)Definethe Data structure
3) Classify Data Structure
4) Explain Algorithm with example

Unit Objectives: Student can able to recall C programming.
Broad Objectives of the unit are:
1. Concepts ofusingpointer function and structure.
2.Data structure definition and classifications.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. **Describe** function, structure? (Level 2)
2. What do you **understand** by Data Structure? (Level 2)
3. **Classify** data structure with examples. (Level 5)
4. **Describe** characteristics of algorithms. (Level 2)
5. **Compare** between linear and non linear data structure. (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria
1. What is the utilization of the following program?

```
main()
{
        int a[]={0,1,2,3,4};
        int  k, *p;
        for(p=a, k=0;p+k<=a+4; p++, k++)
        printf("  %d " , *(p+k));


}
```

QUIZ: related to Topic objective and outcome (new quiz with real world examples)
1)…… function of C is used to allocate a block of memory.
a)malloc() b)calloc()
c)free() d)realloc()

UNIT: 2
Title :**Array and Its Operation**
Day:2

CONTENTS
1) Define Array data structure.
2) Insert an element in to Array.
3) Delete an element from Array.
4)Memory representation: row major and column major

Topic/Unit/Chapter Objectives: Student can able to understand about linear data structure.
Broad Objectives of the chapter/topic are:
1. Concepts of linear data structure.
2. Implementthe algorithm to insert and deletean element from array.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. **Describe** array? (Level 1)
2. **Explain**thealgorithm for insert and delete operation on array data structure. (Level 4)
3. **Explain**with example on row major and column major. (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria
1) Let A be a two dimensional array declared as A [1….10][1….15] of integer. Assuming that each integer takes one memory locations the array is stored in row major order and the first element of the array is stored at location 100, what is the address of the element A[i][j]?

QUIZ: related to Topic objective and outcome (new quiz with real world examples)

1) The number of elements n is called the length ---------- of the array.

a) Upper Bound c) Lower Bound

b) Size d)Variable

2) Arrays are best data structures

a) for relatively permanent collections of data

b) for the size of the structure and the data in the structure are constantly changing

c) for both of above situation

d) for none of above situation

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1) Insert one element into array and delete one element from array.

UNIT: 3

Title:**SingleLinked List**

Day:3

1) Definition of Linked list and its types.
2) Representation of linked list.
3)Operationsof Single Linkedlist(Create,Traverse,Insertion)

Unit Objectives: Student can able to understand about single linked list.

Broad Objectives of the chapter/topic are:

1. Student can able to **understand** linked list. (Level 2)
2. How to **create** a single linked list? (Level 6)
3. **Compare**between array and linked list. (Level 4)

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):

1. **Explain**an algorithm for Creation of single linked list. (Level 4)
2.**Explain** the algorithm of Traversal of single linked list .(Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. Draw a single link list which has 5 nodes.

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1) Implement the following operation of linked list

a)Create list b)Traversal

c)Insert first d)insert last e)Insert Anywhere

UNIT: 3

Title: **Single Linked List**

Day:4

CONTENTS

OperationsofSingleLinkedlist.(Deletion,Searching,Sorting, Reversing)

Unit Objectives: Student can able to **understand** about operation of single linked list

Broad Objectives of the chapter/topic are:

1. Student can able to **understand** single linked list. (Level 2)
2. Howto**explain** the algorithm to Insert and Delete an element from a single linked list? (Level 4)

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. **Explain** an algorithm for Insertion and deletion of single linked list. (Level 4)
2. **Explain** the algorithm of searching the element from single linked list. (Level 4)
3. **Explain** an algorithm for Sorting of single linked list. (Level 4)
4. **Explain** to Reverse single linked list. (Level 4)
5. **Explain** to traverse linked list in reverse order. (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. Write an algorithm of finding the middle node form a single linked list.
2. Binary search is possible or not to find a node from a linked list.

LABORATORY EXPERIMENT: related to the Topic objective and outcome.

1) Implement the following operation of single linked list

a)Delete first b)delete last c)Delete anywhere
d)Sorting e)Reversing f)Traverse(in reverse order)
g)Search the element from list

UNIT:3
Title : Linear Data Structure(Stack)
Day:5

CONTENTS

1)STACK-Definitions, operations
3)Implementations using array
4)Implementations using linked list
5)Application of Stack
6)Arithmetic notation(prefix, postfix, infix)

Unit Objectives: Student can able to **understand** about operation of stack
Broad Objectives of the chapter/topic are:
1. Able to **understand** about Stack Data Structure
2. Student can able to **understand** stack operation (PUSH and POP)
3. Able to understand about how to represent prefix, postfix, and infix notation

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. What do you **understand** by push and pop operation in Stack? (Level 2)
2. **Finding**the over flow and under flow condition for Stack? (Level 4)
3. **Explaining** the real life example of stack? (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. A single array A[1….MAXSIZE] is used to implement stacks. Two stacks grow from opposite ends of the array. Variable Top1 and Top2 (Top1<Top2) point to the location of the topmost element in each stacks .if the space is to be used efficiently .so what is the STACK FULL condition?

QUIZ: related to Topic objective and outcome (new quiz with real world examples)

1. Stack is also called as
   a) Last in first out b) First in last out
   c) Last in last out d) First in first out

2. Inserting an item into the stack when stack is not full is called ……. Operation and deletion of item form the stack, when stack is not empty is called ……..operation.
   a) push, pop b) pop, push
   c)insert, delete d) delete, insert

LABORATORY EXPERIMENT: related to the Topic objective and outcome.

1. Implement Stack Operation in C programming language using array and linked list.

UNIT: 4

Title : Linear Data Structure(STACK)

Day:5

CONTENTS

1)Convert infix to post fix expression(with examples)
2)Evaluation of post fix expression

Topic/Unit/Chapter Objectives: Student can able to understand stack data structure
Broad Objectives of the chapter/topic are:

1. Student can able to understand how to convert infix to post fix expression
2. Student can able to understand how to evaluate post fix expression

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1**. Describe** polish notation? (Level 2)
2. What do you **understand** by reverse polish notation? (Level 2)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. Translating the following infix expression into post fix expression
   A+(B*C – (D/(E+F))*G)*H
2. Evaluate the following Post fix expression (with single digit operand).
   8 2 3 ^ / 2 3 * + 5 1 * -
   Identify the Top two elements of the stack after the first * (operator) is evaluated.

UNIT: 5

Title : Recursion

Day:6

CONTENTS

1) Recursion.
2) Types of Recursion.
3) Tower of Hanoi.
4) Eight Queen Puzzle Problem.

Unit Objectives: Student can able to **understand** about recursion and its classification.
Broad Objectives of the chapter/topic are:

1. Student can able to understand How to apply recursion technique in real life application.
2. Student can able to understand how to draw recursive tree.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. **Compare** between Recursion Vs Iteration. (Level 4)
2. **Describe** Tail recursion? (Level 2)
1. **Explain** the algorithm of Tower of Hanoi. (Level 4)
2.**Outline**a recursive Tree for Tower of Hanoi for n =3. (Level 4)
3. **Explain** the algorithm of 8 queen puzzle problem. (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1) int ABC(int n , int m)

```
{
    if(n==0)
     return(m+1);
else  if (m==0 &&n>0)
    return  ABC(n-1,1);
else   return   ABC(n-1,ABC(n,m-1));
    }
```

2) Draw a recursive Tree for Tower of Hanoi for n =4

QUIZ: related to Topic objective and outcome (new quiz with real world examples)
NA

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1. Construct C programming language for GCD of two number recursive techniques.
2. Construct C programming language for Fibonacci series of two number using recursion.
3. Construct C programming language for tower of Hanoi in recursive technique.
4. Construct C programming language for eight queen puzzle problem in recursive technique.

UNIT: 4
Title : Linear Data Structure(Linear QUEUE)
Day:7

CONTENTS

1)Linear Queue-Definitions
2)Operation of Queue(insert at front ,delete at rear)
3)Implementation using array and linked list

Topic/Unit/Chapter Objectives: Student can able to understand queue data structure
Broad Objectives of the chapter/topic are:
1. Able to understand about linear queue Data Structure
2. Student can able to understand linear queue operation (insert at front ,delete at rear)

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1**. Discuss** the operation in queue? (Level 2)
2. **Explain** the over flow and under flow condition for Queue data structure? (Level 4)
3.Whatdo you **understand by** the real life example of queue? (Level 2)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. What is the difficulties of linear queue and how overcome it?

QUIZ: related to Topic objective and outcome (new quiz with real world examples)

1. Which data structure allows deleting data elements front and inserting at rear?

A. Stack
B. Queues
C. Tree
D. Linked List

2. A ..... is a data structure that organizes data similar to a line in the supermarket, where the first one in line is the first one out.

A. Queue
B. Stacks
C. Both of them
D. Neither of them

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1. Implement Linear Queue Operation in C programming language using array and linked list.

UNIT:4
Title Linear Data Structure(Circular QUEUE)
Day:7

CONTENTS

1)CIRCULAR Queue
2)Operation of CURCULAR Queue(insert at front ,delete at rear ,traverse)
3)Implementation using array and linked list

Unit Objectives: Student can able to understand Circular queue data structure
Broad Objectives of the chapter/topic are:
1. Able to understand about circular queue Data Structure
2. Student can able to understand circular queue operation (insert at front ,delete at rear)
3. Student can able to know how it use full in real life.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. **Discuss** the operation in Circular queue? (Level 2)
2. **Describe** the over flow and under flow condition for Circular Queue data structure? (Level 2)
3. **Outline** the real life example of queue. (Level 4

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria
1.Take a circular queue **CQ** which is allocated 5 memory cells starting from **CQ[0] to CQ[4].**Perform the following operations one by one on it and write down **front** and **rear** value in each and every step.
(i)Insert 23,12,45,33 (ii) Delete two elements (iii) Insert 43, 56 (iv) Delete one element (v) Insert 10

QUIZ: related to Topic objective and outcome (new quiz with real world examples)
1. Let queue be a circular array having size 5. Now front=5 and rear=5 indicates that the queue----------
(a)is empty (b)is full (c) contains only one element (d)none of these
2. A linear list in which elements can be added or removed at either end but not in the middle, is known as
(a) Queue (b) Deque (c) Stack (d) Tree

LABORATORY EXPERIMENT: related to the Topic objective and outcome
1. Implement Circular Queue Operation in C programming language using array

UNIT: 3
Title : Linear Data Structure(Circular Linked List)
Day:8

CONTENTS
1) Circular Linkedlist. (Definition)
2) Operation of circular linked list.
3) Double Linkedlist.(Definition)
4) Operation of Double linked list (Create,Traverse)

Topic/Unit/Chapter Objectives: Student can able to understand Operation of De Queue data structure
Broad Objectives of the chapter/topic are:
1. Student can able to **understand** Circular linked list.
2. How to create, traverse a circular linked list.
3. How to Insert and Delete an element from a circular linked list?
4. Student can able to **understand** double linked list.
5. **How** to Create and traverse the double linked list?
6. Write down the advantages of doubly linked list over singly linked list.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. **Explain** an algorithm for Creation and traversal of Circular linked list. (Level 4)
2. **Explain** the algorithm for insertion and deletion of Circular linked list. (Level 4)
3.**Explain**an algorithm for Creation and traversal (forward and back word direction) of Double linked list. (Level 4)
4. **Compare** between singly linked list and doubly linked list. (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria
1) Draw circular linked lists which have 5 nodes.
2) Draw a double linked list which has 5 nodes.

QUIZ: related to Topic objective and outcome (new quiz with real world examples)
1. The disadvantage in using a circular linked list is.....
A. It is possible to get into infinite loop B. Last node points to first node.
C. Time consuming D. Requires more memory space

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1. Implement the following operation of circular linked list

a)Create b)Traverse c)Insert first d)insert last
e)Delete first f)delete last

TOPIC/UNIT/ CHAPTER: 3
Title: Doubly linked list
Day:6

CONTENTS

Operations of Doubly linked list(Insert, Delete)

Topic/Unit/Chapter Objectives: Student can able to **understand** about Circular linked list and its operation.
Broad Objectives of the chapter/topic are:
1. How to Insert and Delete an element from a double linked list.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):

1. **Explain** an algorithm for insertion of Double linked list. (Level 4)
2. **Explain** an algorithm for deletion of Double linked list. (Level 4)

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1)Implement the following operation of double linked list
a)Create b)Traverse
c)Insert first d)insert last
e)Insert at specified position f)Delete first g)Delete at specified position
h)delete last

UNIT: 3
Title: Linear Data Structure(Application of linked list)
Day:7

CONTENTS

1.Representation of Polynomial expression using array
2. Representation of Polynomial expression using linked list
3.Polynomial addition using linked list
4.Polynomial multiplication using linked list

Topic/Unit/Chapter Objectives: Student can able to **understand** about double linked list and its operation.
Broad Objectives of the chapter/topic are:

1. Student can able to **understand** polynomial addition.

2. Student can able to **understand** polynomial multiplication.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. **Explain** an algorithm for Polynomial addition. (Level 4)
2. **Explain** an algorithm for Polynomial multiplication. (Level 4)

LABORATORY EXPERIMENT: related to the Topic objective and outcome
1. Implement the following operation of linked list
a. Polynomial addition.
b. Polynomial multiplication

UNIT: 6
Title : NON -Linear Data Structure(Tree)
Day:8

CONTENTS

1.Define Tree and its terminology
2.Definition of binary tree with examples
3.Types of Tree(complete , strictly , extended)
4.Expression Tree

Topic/Unit/Chapter Objectives: Student can able to **understand** about operation of double linked list
Broad Objectives of the chapter/topic are:
1. Student can able to **understand** Tree.
2.Concepts of binary tree

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. What do you **understand** by complete binary tree? (Level 2)
2. **Describe** the following terms : Degree , terminal ,root node, height , child (Level 2)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria NA
1) Prove that $n_o = n_2+1$ where no is the terminal and n2 is non terminal node degree 2.

QUIZ: related to Topic objective and outcome (new quiz with real world examples)
1.In array representation of binary tree, if the index number of a child node is 6 then the index number of its parent node is
(a) 2 (b) 3 (c) 4 (d) 5

UNIT: 6
Title : NON -Linear Data Structure(BST)
Day:9

CONTENTS

1.Definitions of BST
2. Construct BST from in order, pre order and post order traversal.
3.BST operations using algorithms[Create,Traverse(Recursive and non-recursive)]

Topic/Unit/Chapter Objectives: Student can able to **understand** about application of link list
Broad Objectives of the chapter/topic are:
1. Student can able to know the operation of binary search tree.
2. Student can able to know how to construct BST from pre order, post order and in order.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1**. Explain** the Algorithm for finding number of node from a BST.(Level 4)
2. **Explain** an algorithm for finding in order predecessor of root node from non- empty BST.(Level 4)
3. **Describe** BST. (Level 2)
4. **Write** an algorithm for create and traverse BST. (Level 1)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria
1. Write an algorithm inorder traversal of BST in non-recursive way.

LABORATORY EXPERIMENT: related to the Topic objective and outcome
1. Implement the following BST Operation
a)Create b)Traverse(preorder, in order, post order in recursive way)
c)Traverse(preorder, in order in non- recursive way)

UNIT: 6 Title : NON -Linear Data Structure(BST) **Day:10**
CONTENTS BST operations using algorithms(Insertion)
Topic/Unit/Chapter Objectives: Student can able to **understand** about nonlinear data structure like Tree and its terminology. Broad Objectives of the chapter/topic are: 1.How to insert a node in recursive as well as non-recursive way in a BST?
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1**. Explain** the Algorithm to insert a node in a BST.(Level 4)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1.Insert following elements in BST:44,12,34,78,90,6,22,87
1. Implement the following BST Operation a) Insert the node using recursive and non-recursive way

UNIT: 6 Title : NON -Linear Data Structure(BST) **Day:11**
CONTENTS BST operations using algorithms(Deletion)
Topic/Unit/Chapter Objectives: Explanation of operation of binary search tree. Broad Objectives of the chapter/topic are: 1**. Able to understand** the Algorithm for deleting node from a BST.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1**. Explain** the Algorithm for deleting node from a BST.(Level 4)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1. Write an Algorithm for finding in order successor of root node.
LABORATORY EXPERIMENT: related to the Topic objective and outcome 1. Implement the following BST Operation Delete the node

UNIT: 6 Title : NON -Linear Data Structure(Threaded Binary Tree) **Day:12**
CONTENTS **1.**Threaded Binary Tree 2. Classification of Threaded Binary Tree.

3. Traversal of Threaded Binary tree.
Topic/Unit/Chapter Objectives: Explanation of operation of threaded binary tree. Broad Objectives of the chapter/topic are:. 1. Student can able to **understand** about threaded binary tree. 2. Student can able to know the classification of Threaded Binary tree
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. Whatdo you **understand** by Threaded Binary tree? (Level 2) 2. **Implement**an algorithm for In order Traverse of Threaded Binary Tree? (Level 3) 3. **Compare** the efficiency between threaded binary tree and BST? (Level 4)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1. Draw a Full Threaded Binary Tree which has seven nodes.
QUIZ: related to Topic objective and outcome (new quiz with real world examples) 1.If a binary tree is threaded for inorder traversal a right NULL link of any node is replaced by the address of its (a) successor (b) predecessor (c)root (d)own

UNIT: 6 Title:NON -Linear Data Structure (AVL tree) **Day:13**
CONTENTS 1. AVL Tree-Definitions 2. Balance Factor 3. Operation of AVL Tree(Single rotations, Double rotations)
Topic/Unit/Chapter Objectives: Explanation of more efficient Data structure than binary search tree. Broad Objectives of the chapter/topic are: 1. Student can able to **understand** about AVL tree. 2. Student can able to know the Operation of AVL tree.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. What do you **understand** by AVL tree? (Level 2) 2. **Complete** the full form of AVL? (Level 3) 3. **Compare** BST and AVL tree.(Level 4) 4. What do you **understand** by pivot node in AVL tree? (Level 2) 5. What do you **understand** by Balance factor? (Level 2)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1. Draw all the general form of rotation for insert in an AVL tree. 2. Insert the following keys in AVL tree and show the rotations. 8, 12, 9, 11, 7, 6,66,2,1,44
QUIZ: related to Topic objective and outcome (new quiz with real world examples) 12. A binary search tree whose left subtree and right subtree differ in hight by at most 1 unit is called …… A. AVL tree B. Red-black tree C. Lemma tree D. None of the above

TOPIC/UNIT/ CHAPTER: 6 Title : NON -Linear Data Structure(AVL Tree) **Day:14**
CONTENTS Explain Ro R1 R-1 rotation for delete an element

Topic/Unit/Chapter Objectives: Explanation of more efficient Data structure than binary search tree. Broad Objectives of the chapter/topic are: 1. Student can able to **understand** about rotation for delete a node from AVL tree
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. **Evaluate** the time complexity of AVL Tree? (Level 5)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1.Draw all the general form of rotation for delete an element from an AVL tree

TOPIC/UNIT/ CHAPTER: 6 Title: NON -Linear Data Structure(B Tree) Date: 27/10/21 Day: Wesnesday
CONTENTS **1.** Explain B Tree. **2.** Operation of B tree with example
Topic/Unit/Chapter Objectives: Explanation of deletion of element form B tree. Broad Objectives of the chapter/topic are: 1. Student can able to **understand** about B Tree. 2. Student can able to **know** the Operation of B tree.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. **Describe** B Tree tree?(Level 2) 2.**Discuss** the element is to be insert into B- Tree? .(Level 2) 3. **Describe** an element is to be Deleted from B- Tree? (Level 2)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1. Insert The following element in to B Tree of order 4 : 4,7,1,4,22,9,11,55,33,88,77 2. Delete The following element in to B Tree of order 4 : 4,7,1,4,22,9,11,55,33,88,77

UNIT: 1 Title : **<u>Algorithm efficiency and analysisand Sorting</u>** **Day:15**
CONTENTS 1) Define asymptotic notation. 2) Demonstrate the classification of asymptotic notation.
Topic/Unit/Chapter Objectives: Explanation of more efficient Data structure Broad Objectives of the chapter/topic are: 1. Student can able to relate about Big O, Theta and Omeganotation. 2. Student can able to find complexity of an algorithm.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1.**Explain** Big O , Theta, Omega notation.(Level 4)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1. Prove that $3n^2 + 7n = O(n^2)$ 2. Prove that $3n^2 + 7n = \Omega(n^2)$ 3. Prove that $3n^2 + 7n = \Theta(n^2)$ 4. Short notes on asymptotic notations.

QUIZ: related to Topic objective and outcome (new quiz with real world examples) 1.Which of the following shows the correct relationship among some of the more common computing times for algorithm? (a)O (log n) <O (n) <O (n*log n) <O (2^n) <O (n^2) (b)O (n) <O (log n) <O (n* log n) <O (2^n) <O (n^2) (c)O (n) < O (log n) <O (n* log n) <O (n^2) <O (2^n) (d) O (log n) <O (n) <O (n*log n) <O (n^2) <O (2^n)

UNIT: 9 Title : Searching **Day:16**
CONTENTS 1)Searching- Linear Search, Binary search, Interpolation search 2)Time complexity of Linear Search, Binary search, Interpolation search
Topic/Unit/Chapter Objectives: Explanation of Sorting Broad Objectives of the chapter/topic are: 1. Student can able to understand about linear searching and its time complexity 2. Student can able to understand about binary searching and its time complexity 3. Student can able to understand about interpolation searching and its time complexity
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. **Describe** searching? (Level 2) 2. **Compare**Best, average and worst case time complexity of linear search. (Level 4) 3.**Compare**Best, average and worst case time complexity of binary search. (Level 4)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1)Search an smallest element from a matrix
QUIZ: related to Topic objective and outcome (new quiz with real world examples) 1.The worst case time complexity of binary search is (a)O (n^2) (b) O (n) (c) O (log n) (d) O (n*log n)
LABORATORY EXPERIMENT: related to the Topic objective and outcome 1) Implement linear search, binary search and interpolation search in C programming language

UNIT: 9 Title :Sorting **Day:17**
CONTENTS 1. Bubble, Insertion sort 2. Time Complexity Analysis
Topic/Unit/Chapter Objectives: Student can able to understand about algorithm and how analyze time complexity of an algorithm. Broad Objectives of the chapter/topic are: 1. **Explain**Bubble, Insertion sort algorithm. (Level 4) 2. **Explain** the time complexity analysis. (Level 4)
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. **Classify** the best, worst and average case time complexity of bubble sort. (Level 2)

2. **Classify** the best ,worst and average case time complexity of insertion sort ?(Level 2) 3. **Describe** modified bubble sort?(Level 2)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1.Draw the step of Bubble sort for the following data element : 5,1,7,2,4,8 2.Draw the step of Insertion sort for the following data element : 5,1,7,2,4,8
QUIZ: related to Topic objective and outcome (new quiz with real world examples) 1.The best case time complexity of the bubble sort technique is (a) O (n) (b)$O(n^2)$ (c)O(nlogn) (d)O(logn) 2.The worst case time complexity of the insertion sort technique is (a) O (n) (b)$O(n^2)$ (c)O(nlogn) (d)O(logn)
LABORATORY EXPERIMENT: related to the Topic objective and outcome 1. Implement program for following sorting algorithm a)Bubble sort. b)Insertion sort

UNIT: 8 Title: Sorting **Day:18**
CONTENTS 1.Selection Sort, Merge sort 2. Time Complexity Analysis
Topic/Unit/Chapter Objectives: Student can able to understand about searching algorithm. Broad Objectives of the chapter/topic are: 1. **Explain** selection and merge sort algorithm. (Level 4) 2. **Explain** the time complexity analysis. (Level 4)
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): **1.Classify** the best ,worst and average case time complexity of selection sort ?(Level 2) 2.**Classify** the best ,worst and average case time complexity of selection sort ?(Level 2)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1.Draw the step of Selection sort for the following data element : 15,1,70,2,41,87 2.Draw the step of Insertion sort for the following data element : 5,11,7,12,47,8
QUIZ: related to Topic objective and outcome (new quiz with real world examples) 1.The best case time complexity of the merge sort technique is (a) O (n) (b)$O(n^2)$ (c)O(nlogn) (d)O(logn)
LABORATORY EXPERIMENT: related to the Topic objective and outcome 2. Implement program for following sorting algorithm a)Selection sort a)Merge sort

UNIT: 8 Title :Sorting **Day:19**
CONTENTS 1.Quick sort algorithm and time complexity analysis
Topic/Unit/Chapter Objectives: student can able to understand about sorting and its time complexity Broad Objectives of the chapter/topic are: 1. Student can able to **understand** the algorithm of Quick sort 2. student can able to **understand** Time complexity of Quick sort
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1.**Compare** the best ,worst and average case time complexity of Quick Sort ?(Level 4)

2. **Find** the strategy which is used to implement Quick sort?(Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. Draw the step of Quick sort for the following data element : 5,1,7,2,4,8,9,11,6

QUIZ: related to Topic objective and outcome (new quiz with real world examples)

1.The best case time complexity of the quick sort technique is

(a) O (n) (b)$O(n^2)$ (c)O(nlogn) (d)O(logn)

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1.Implement program for following sorting algorithm

a)Quick sort

UNIT:8

Title: Sorting

Day:20

CONTENTS

1. Shell sort and Radix sort
2. Time complexity analysis

Topic/Unit/Chapter Objectives: student can able to understand about more efficient sorting Algorithm and its time complexity.

Broad Objectives of the chapter/topic are:

1. Student can able to **understand** Shellsort.
2. Student can able to **understand** Radix sort.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):

1. **Implement** the algorithm of Shell Sort.
2. **Implement** the algorithm of Radix Sort?

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1.Draw the step of Shell sort for the following data element : 511,100,79,24,402,801,319,101,604.666,222,873,471,902,184

2.Draw the step of Radix sort for the following data element : 511,100,79,24,402,801,319,101,604.666,222,873,471,902,184

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1.Implement program for following sorting algorithm

a)Shell sort b)Radix sort

UNIT: 8

Title Sorting

Day:21

CONTENTS

1)Algorithm for Heap sort
2)Construction of Heap tree
3)Time complexity analysis

Topic/Unit/Chapter Objectives: student can know the algorithm and complexity analysis of merge sort.

Broad Objectives of the chapter/topic are:

3. Student can able to **understand** the algorithm of heap sort

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):

1.**Compare**the best ,worst and average case time complexity of Heap Sort ?(Level 4)

2. **Explain** the Heap sort algorithm? (Level 4)

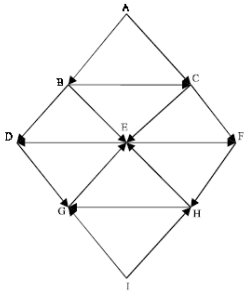
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1.Draw the step of Heap sort for the following data element : 5,1,7,2,4,8,9,11,6
LABORATORY EXPERIMENT: related to the Topic objective and outcome 1.Implement program for following sorting algorithm a)Heap sort

UNIT: 5 Title : NON -Linear Data Structure(Graph) **Day:22**
CONTENTS 1)Graph definition 2)Types of Graph: Directed, undirected, complete graph 3)Definitions- weighted/un-weighted edges, sub-graph, degree, cut-vertex/articulation point, pendant node, clique, complete graph, connected components – strongly connected component, weakly connected component, path, shortest path, isomorphism
Topic/Unit/Chapter Objectives: student can know the algorithm and complexity analysis of Heap sort. Broad Objectives of the chapter/topic are: 1.Able to understand definition of graph. 2.Able to learn deferent terminology of graph 3. Able to understand different types of graph?
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. **Describe** the definition of graph? (Level 2) 2. **Identify** directed or undirected graph?(Level 4) 3. **Describe** the definition of different types of graphs? (Level 2) 4. **Identify** isomorphism of graph? (Level 4)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1.Drawan un directed graph which have 8 vertex and represent it using array.
QUIZ: related to Topic objective and outcome (new quiz with real world examples) 1.The vertex, removal of which makes a graph disconnected, is called (a)pendant vertex (b)bridge (c)articulation point (d)none of these

UNIT: 4 Title : NON -Linear Data Structure(Graph) **Day:23**
CONTENTS 1) Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list. 2)Graph Traversal-BFS and DFS (algorithms with examples)
Topic/Unit/Chapter Objectives: student can know the algorithm and complexity analysis of Radix sort. Broad Objectives of the chapter/topic are: 1. Able to understand adjacency matrix and list. 2. Able to understand BFS and DFS traversal of graphs 3. Comparison study about BFS and DFS
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. How to **construct** adjacency matrix of a graph? (Level 6) 2. How to **construct** a graph using linked list? (Level 6) **3. Explain** DFS with example. (Level 4) **4. Describe** the data structure need to develop DFS? (Level 2) **5. Explain** BFS with example. (Level 4) **6. Describe** the data structure need to develop BFS? (Level 2)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. Traverse the following Graph using DFS and BFS



TOPIC/UNIT/ CHAPTER: 5

Title : NON -Linear Data Structure(Graph)

Day:24

CONTENTS

1)Spanning Tree
2) Minimum Spanning Tree
3)Prim's algorithm.

Topic/Unit/Chapter Objectives: how to define graph and how to represent graph

Broad Objectives of the chapter/topic are:

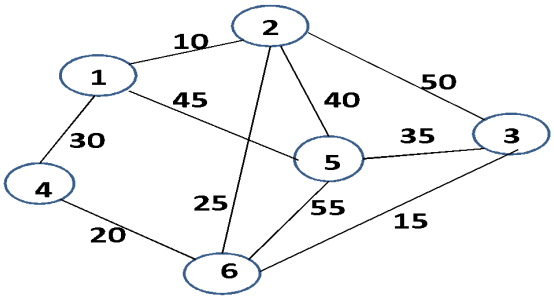
1.Able to know about spanning tree.
2.Able to understand minimum spanning tree.
3.Able to know about Prim's algorithm with example.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):

1.**Describe**minimum spanning tree? (Level 2)
2. **Explain** prim's algorithm with example. (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. Using Prim's Algorithm to find the minimum spanning tree (MST) of the given graph.



UNIT: 10

Title :**Hashing**

Day:25

CONTENTS

1)Definition of Hashing
2)Different types of Hashing
3)Collision Resolution techniques

Topic/Unit/Chapter Objectives: student can able to relate how sparse matrix can utilize for space optimization in memory Broad Objectives of the chapter/topic are: 1. Student can able to understand hashing. 2. Student can able to understand how many types of hashing techniques are there? 3. Student can able to understand about collision resolution techniques.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1.**Describe**Hashing .(Level 2) 2.**Describe** the utilization of different types of hashing?(Level 2) 3.**Describe**different types of collision resolution techniques. (Level 2)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1. Calculate load factor.

TOPIC/UNIT/ CHAPTER: Title **:WBUT QUESTION ANSWER SESSION** **Day:26**
CONTENTS Last 5 years university question paper.
Topic/Unit/Chapter Objectives: student can able to relate how sparse matrix can utilize for space optimization in memory Broad Objectives of the chapter/topic are: 1. They are able to explain to analyze, investigate and evaluate. 2. They are able to judge how to apply theory.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): **Discussion most of the university questions in last 5 years.**

a) Teaching Strategy/Method (describe instructional methods, usage of ICT, efficient and engaging instructions and display the best practices on institutional website)

1) To give Assignments
2) By giving more interesting examples
3) Giving lectures in power point presentation

b) Strategy to support weak students

1) To engage the weak students in habit of studying, I give him some easy questions in regular basis.
2) Some weak students also have a problem that they forget what they learn. In my class I always give some tips on how to recall and how to write systematically.
3) Weak students need special attention even after college hours. I always give some extra hours to a weak student.

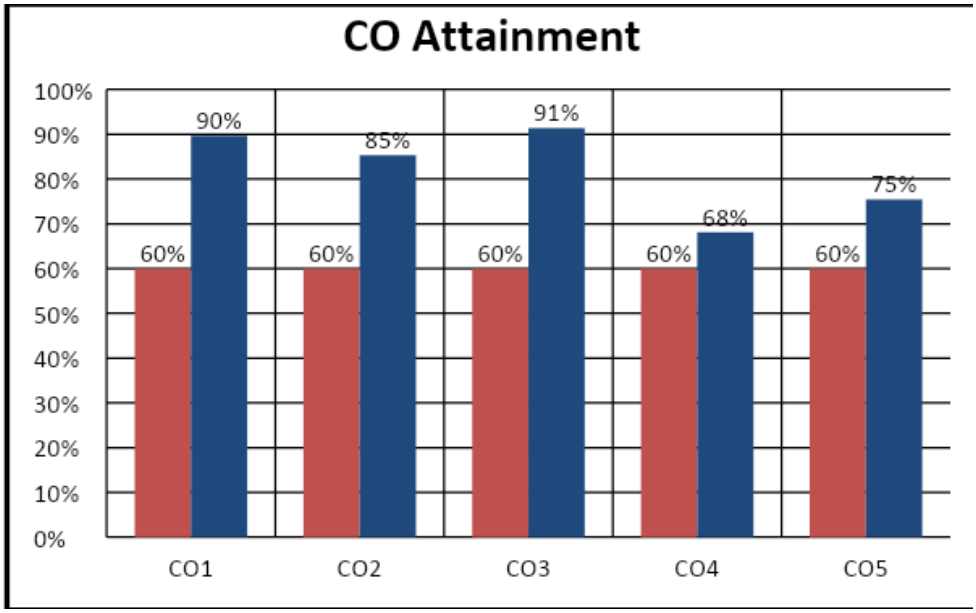
c) Strategy to encourage bright students

1) Have an extra challenge ready that allows the student to go deeper into the subject, learn a little more, or apply a skill he has just learned in a new way.
2) Some students are engaged with the final year students for their final project.

d) Efforts to keep students engaged

1) Regular basis Home Work.
2) 5-10 minutes spend in an every class for question answer session.
3) Quiz in regular basis.
4) Some technical assignments in group wise.

e) Analysis of Students performance in the course (internal) (labs, seminars, tests, assignments, quiz, exam etc)



Comments:

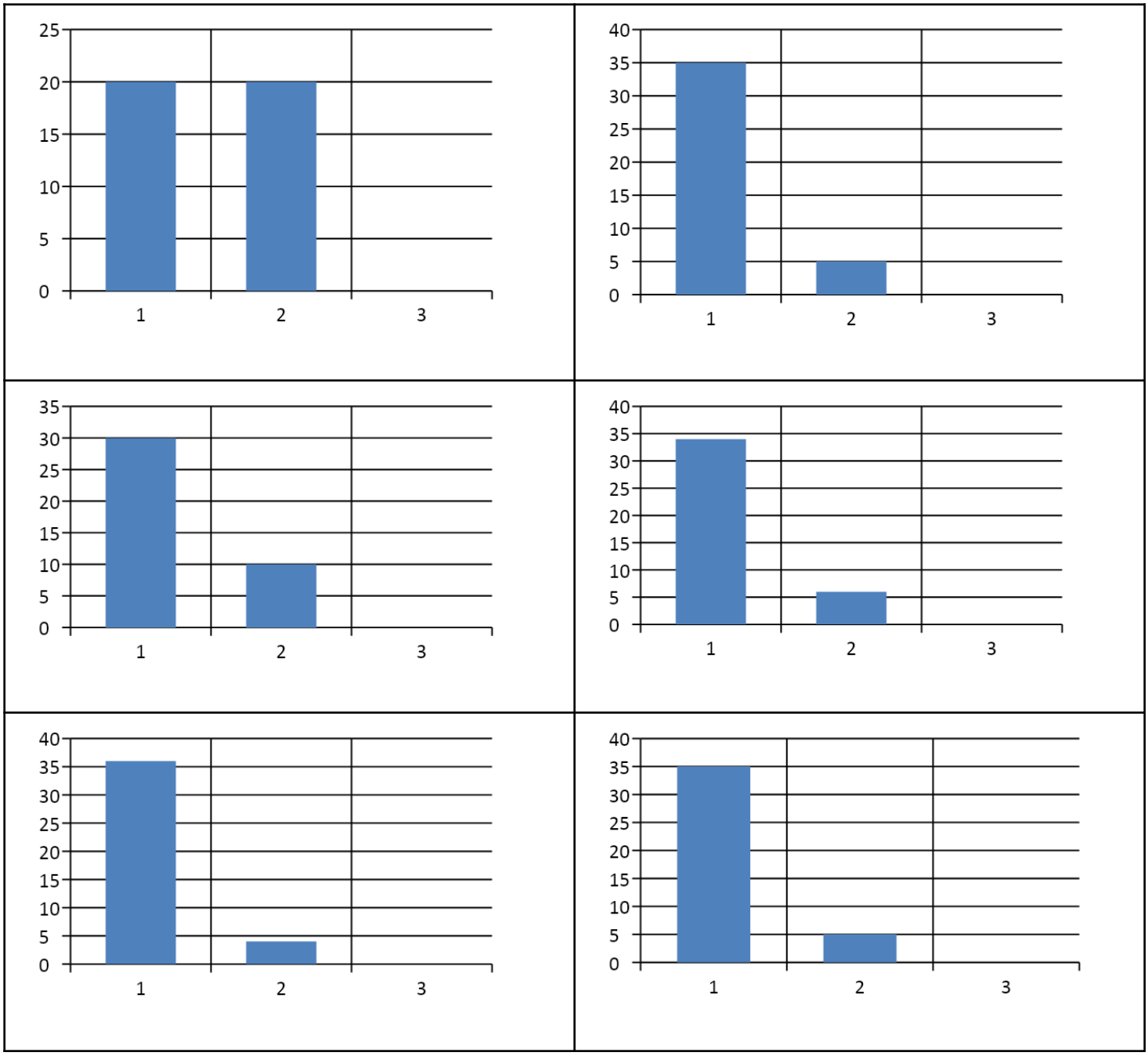
- 90% students have attained the set target of 60% marks for CO1
- 85% students have attained the set target of 60% marks for CO2
- 91% students have attained the set target of 60% marks for CO3
- 68% students have attained the set target of 60% marks for CO4
- 75% students have attained the set target of 60% marks for CO5

f) Analysis of Students performance in the course (university results)

	Target Course Outcome%	TOTAL STUDENTS	TOTAL STUDENT WHO ATTAINED OUTCOME	% STUDENTS WHO ATTAINED THE OUTCOME

University Result	**60%**	**58**	**36**	**62%**

g)Student Feedback



h)Teacher Self-Assessment (at the completion of course)

At the completion of course I have understood that CO1 and CO5has reached the attainment levels but not satisfactorily.That'swhy more assignments and quiz questions should be provided.

i) Recommendations/Suggestions for improvement by faculty

Text books are available in the library but in previous edition. That's why books should be updated.

Siliguri Institute of Technology
INTERNAL ASSESSMENT REPORT
Paper Name: Data Structure & Algorithm
Paper Code: PC-CS 301

FACULTY NAME :**Ms.SUTAPA BHATTACHARYA** **YEAR: 2020**

STREAM: **B.TECH[CSE]** YEAR: **2ND** SEMESTER: **IST** SECTION: **B**

SN	ROLL NO.	NAME	ATTENDANCE [5 MARKS]		MARKS IN INTERNAL EXAM[15 MARKS]			QUIZ [10 MARKS] MARKS=[((I+II)/30)*100]/10			TOTAL [30 MARKS]
			TOTAL %	MARKS	I	II	AVG	Q-I [15]	Q-II [15]	MARKS	
1	11900119049	PAWAN KUMAR SAH	89	5	27	28	14	8	13	7	26
2	11900119050	AJAY SHIL	75	4	27	28	14	14	11	8	26
3	11900119051	SOMESH KUMAR THAKUR	95	5	27	27	14	9	8	6	25
4	11900119052	AMAN RAZA	76	4	28	27	14	13	13	9	27
5	11900119053	ABHILASHA GUPTA	76	5	17	27	11	13	7	7	23
6	11900119054	PANAKJ KUMAR	80	3	24	20	11	11	13	8	22
7	11900119055	ALOK KUMAR	95	4	23	18	10	9	7	5	19
8	11900119056	PIYUSH PRAKASH	95	5	23	29	13	10	14	8	26
9	11900119057	ANOUSHKA GHOSH	95	5	26	29	14	9	7	5	24
10	11900119058	RAUSHAN KUMAR	95	5	29	28	14	14	10	8	27

11	11900119059	DIVYANGANA GANGULY	75	5	27	28	14	13	13	9	28
12	11900119060	SUMIT KUMAR	82	4	27	22	12	13	8	7	23
13	11900119061	AGNIVA SENGUPTA	96	5	27	26	13	15	14	10	28
14	11900119062	ASHUTOSH SHARAN SINGH	80	4	23	29	13	8	7	5	22
15	11900119063	SANGITA MALLICK	85	4	19	22	10	10	6	5	19
16	11900119064	BIKASH KUMAR SINGH	75	5	10	22	8	7	6	4	17
17	11900119065	AABHASH JAIN	95	5	24	26	13	14	10	8	26
18	11900119066	CHINMOY BISWAS	85	4	25	21	12	15	10	8	24
19	11900119067	DEEPSIKHA ROY	85	4	23	24	12	12	8	7	23
20	11900119068	AKSHAT KUMAR GUPTA	96	5	9	22	8	11	11	7	20
21	11900119069	HARSH VARDHAN	89	4	21	20	10	12	8	7	21
22	11900119070	SATISH KUMAR	75	5	29	28	14	10	14	8	27
23	11900119071	RIYA CHATTERJEE	95	5	25	24	12	12	14	9	26
24	11900119072	ROHAN MUKHERJEE	10	3	AB	AB	AB	AB	AB	AB	12
25	11900119073	SOUMYA MAJUMDER	76	5	16	22	10	14	10	8	23
26	11900119074	SHREYA	80	4	26	9	9	10	11	7	20
27	11900119075	ADITYA SINGH	95	5	28	25	13	15	10	8	26

28	11900119076	TANIBHA MAJUMDER	95	4	29	17	12	7	7	5	21
29	11900119077	SAUMYODIP CHATTERJEE	95	5	25	15	10	11	6	6	21
30	11900119078	SAYANTAN BHOWMICK	95	5	24	24	12	13	10	8	25
31	11900119079	TANIYA GHOSH	75	4	24	29	13	15	10	8	25
32	11900119080	RITIKA MUKHERJEE	82	4	15	24	10	9	12	7	21
33	11900119081	SABARNA BISWAS	96	5	21	18	10	8	5	5	20
34	11900119082	SHIVAM TALUKDAR	80	3	10	11	5	12	8	7	15
35	11900119083	DEBASMITA TALUKDAR	85	5	14	21	9	10	5	5	19
36	11900119084	TANMAY SEN	75	5	10	9	5	9	11	7	17
37	11900119085	SAYANBRATA SAHA	95	3	12	13	6	11	6	6	15
38	11900119086	KESHAV KUMAR	85	5	17	29	12	15	13	9	26
39	11900119087	ASHISH GUPTA	85	4	10	29	10	15	10	8	22
40	11900119088	KESHAV AGARWAL	96	3	14	18	8	9	8	6	17
41	11900119089	SUBHADIP SARKAR	89	3	10	11	5	8	5	4	12
42	11900119090	UTPAL KUMAR	75	4	12	21	8	15	8	8	20
43	11900119091	PRITAM PAUL	95	4	17	9	7	10	5	5	16
44	11900119092	KUNDAN KUMAR	76	3	10	13	6	9	8	6	15
45	11900119093	AMISHA SINGH	76	4	14	17	8	10	14	8	20
46	11900120092	**SubhankarSaha**	95	4	10	9	5	9	8	6	15

47	11900120093	**BishalSaha**	75	4	12	13	6	10	11	7	17
48	11900120094	**Pinki Deb**	82	4	17	17	9	13	12	8	21
49	11900120095	**SristiTalapatra**	96	5	17	14	8	14	9	8	21
50	11900120096	**Didhitiraj Chakraborty**	80	5	17	17	9	11	5	5	19
51	11900120097	**Ushna Roy**	89	5	27	28	14	8	13	7	26
52	11900120098	**Sandip Deb**	75	4	27	28	14	14	11	8	26
53	11900120099	**Indranil Roy**	95	5	27	27	14	9	8	6	25
54	11900120100	**Debopriyo Sarkar**	76	4	28	27	14	13	13	9	27
55	11900120101	**Nayan Kumar Sinha**	76	5	17	27	11	13	7	7	23
56	11900120102	**Tuhin Ghosh**	80	3	24	20	11	11	13	8	22
57	11900120103	**Arnab Saha**	95	4	23	18	10	9	7	5	19
58	11900120104	**Ishani Singh**	95	5	23	29	13	10	14	8	26

Siliguri Institute of Technology
LIST OF PRACTICAL'S
Paper Name: Data Structure& Algorithm
Paper Code PCC- CS 391

SN	Details of Experiment(s)	Hours Allotted
1	Implement the following Operation of Array data structure : 1) Insert and delete an element in to an Array. 2) Traverse the array.	3 HRS
2	Implement the following Operation of Single linked list : 1) Create and Traverse a single linked list. 2) Insert and delete an element from a list 3) Reverse a single list. 4)Searching the element from the list 5)Sorting the node values in ascending order	3 HRS
3	1) Implement The following Stack Operation using Array and Linked List : a)PUSH() b)POP() c) Traversal 2)Write a program to implement Tower of Hanoi and 8 queen puzzle problem using recursion	3 HRS

4	1)Implement The following linear Queue Operation using Array and Linked list : a)Enqueue() b)Dequeue() c) Traversal 2)Implement The following Circular Queue Operation using Array : a)Enqueue() b)Dequeue() c) Traversal	3 HRS
5	Implement The following Double ended Queue Operation using Array : a)Insert left() b)Insert right() c) Delete left() d) Delete right() e)Traversal()	3 HRS
6	Implement the following Operation of Double linked list : 1) Create and Traverse a double linked list. 2) Insert and delete an element from a list.	3 HRS
7	Implement the following Operation of Circular linked list : 1) Create and Traverse a double linked list. 2) Insert and delete an element from a list.	3 HRS
8	Write a program to implement polynomial addition and multiplication using linked list.	3 HRS
9	Implement The following Binary search Tree operation : a) Insert an element b) Delete an element c) Search an element	3 HRS
10	Develop the following sorting algorithm: a)Bubble sort b)Selection sort c) Insertion Sort d)Merge sort	3 HRS
11	Develop the following sorting algorithm: a)Quick sort b)Heap sort c)Shell sort	3 HRS
12	Develop the following searching algorithm: Linear Search, Binary Search and Interpolation search	3 HRS

Siliguri Institute of Technology
SESSIONAL/PRACTICAL PERFORMANCE RECORD
Paper Name: Data Structure and Algorithm Lab
Paper Code: PCC-CS391

FACULTY NAME :**Ms SUTAPA BHATTACHARYA**

YEAR: 2020

STREAM: **B.TECH[CSE]** YEAR: **3RD** SEMESTER: **IST** SECTION:**B**

SN	ROLL NO	NAME	Lab_A1(P1,P2,P6, P7,P8)Marks:16	Lab_A2(P3,P4 ,P5)Marks:9	Lab_A3(P 9) Marks:4	Lab_A4(P10, P11,P12) Marks:11	TOTAL[40]

1	11900119049	PAWAN KUMAR SAH	15	8	4	9	**36**
2	11900119050	AJAY SHIL	14	9	4	11	**38**
3	11900119051	SOMESH KUMAR THAKUR	14	9	4	11	**38**
4	11900119052	AMAN RAZA	13	9	4	11	**37**
5	11900119053	ABHILASHA GUPTA	7	5	4	8	**24**
6	11900119054	PANAKJ KUMAR	10	6	4	9	**29**
7	11900119055	ALOK KUMAR	9	6	4	9	**28**
8	11900119056	PIYUSH PRAKASH	14	9	4	11	**38**
9	11900119057	ANOUSHKA GHOSH	12	9	4	11	**36**
10	11900119058	RAUSHAN KUMAR	14	9	4	11	**38**
11	11900119059	DIVYANGANA GANGULY	7	7	2	4	**21**
12	11900119060	SUMIT KUMAR	13	8	4	10	**35**
13	11900119061	AGNIVA SENGUPTA	14	9	4	11	**38**
14	11900119062	ASHUTOSH SHARAN SINGH	13	9	4	11	**37**
15	11900119063	SANGITA MALLICK	13	8	4	11	**36**
16	11900119064	BIKASH KUMAR SINGH	11	8	4	9	**32**
17	11900119065	AABHASH JAIN	14	9	4	11	**38**
18	11900119066	CHINMOY BISWAS	13	8	4	11	**36**
19	11900119067	DEEPSIKHA ROY	13	9	4	9	**35**
20	11900119068	AKSHAT KUMAR GUPTA	11	8	4	9	**32**
21	11900119069	HARSH VARDHAN	11	9	4	11	**35**
22	11900119070	SATISH KUMAR	12	8	4	11	**36**
23	11900119071	RIYA CHATTERJEE	11	8	3	8	**30**
24	11900119072	ROHAN MUKHERJEE	14	9	4	11	**38**
25	11900119073	SOUMYA MAJUMDER	14	7	4	10	**35**
26	11900119074	SHREYA	8	6	3	7	**24**
27	11900119075	ADITYA SINGH	14	8	4	10	**36**
28	11900119076	TANIBHA MAJUMDER	11	7	4	10	**32**
29	11900119077	SAUMYODIP CHATTERJEE	13	9	4	9	**35**
30	11900119078	SAYANTAN BHOWMICK	13	9	4	11	**37**
31	11900119079	TANIYA GHOSH	14	9	4	11	**38**
32	11900119080	RITIKA MUKHERJEE	13	8	4	10	**35**
33	11900119081	SABARNA BISWAS	11	9	4	9	**33**
34	11900119082	SHIVAM TALUKDAR	8	6	2	8	**24**
35	11900119083	DEBASMITA TALUKDAR	8	6	2	6	**22**
36	11900119084	TANMAY SEN	11	6	3	9	**29**
37	11900119085	SAYANBRATA SAHA	11	6	3	9	**29**

38	11900119086	KESHAV KUMAR	13	9	4	11	**37**
39	11900119087	ASHISH GUPTA	13	9	4	10	**36**
40	11900119088	KESHAV AGARWAL	12	9	4	11	**35**
41	11900119089	SUBHADIP SARKAR	15	8	4	9	**36**
42	11900119090	UTPAL KUMAR	14	9	4	11	**38**
43	11900119091	PRITAM PAUL	14	9	4	11	**38**
44	11900119092	KUNDAN KUMAR	13	9	4	11	**37**
45	11900119093	AMISHA SINGH	7	5	4	8	**24**
46	11900120092	**SubhankarSaha**	10	6	4	9	**29**
47	11900120093	**BishalSaha**	9	6	4	9	**28**
48	11900120094	**Pinki Deb**	14	9	4	11	**38**
49	11900120095	**SristiTalapatra**	12	9	4	11	**36**
50	11900120096	**Didhitiraj Chakraborty**	14	9	4	11	**38**
51	11900120097	**Ushna Roy**	7	7	2	4	**21**
52	11900120098	**Sandip Deb**	13	8	4	10	**35**
53	11900120099	**Indranil Roy**	14	9	4	11	**38**
54	11900120100	**Debopriyo Sarkar**	13	9	4	11	**37**
55	11900120101	**Nayan Kumar Sinha**	13	8	4	11	**36**
56	11900120102	**Tuhin Ghosh**	11	8	4	9	**32**
57	11900120103	**Arnab Saha**	14	9	4	11	**38**
58	11900120104	**Ishani Singh**	13	8	4	11	**36**

CERTIFICATE

I, the undersigned, have completed the course allotted to me as shown below

Sl. No.	Semester	Subject with Code	Total Chapters	Remarks
1.	3rd	Data Structure& Algorithm (PCC-CS301) Data Structure & Algorithm Lab (PCC-CS 391)	10	

Date :	**Signature of Faculty**

Submitted to HOD

Certificate by HOD

I, the undersigned, certify that **Prof. SutapaBhattacharya**has completed the course work allotted to him satisfactorily / not satisfactorily.

Date :	**Signature of HOD**

Submitted to Director

Date :	**Signature of Director**