I

Name _____

Roll No. _____ Year 20____20____

Exam Seat No. _____

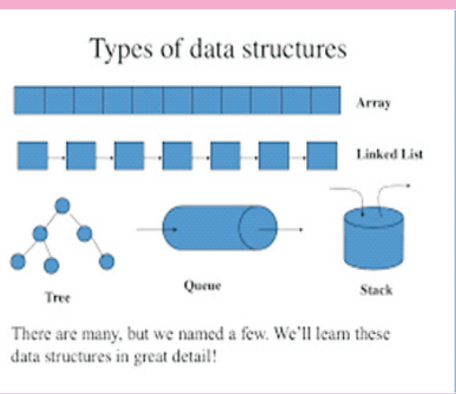
COMPUTER GROUP | SEMESTER - III | DIPLOMA IN ENGINEERING AND TECHNOLOGY

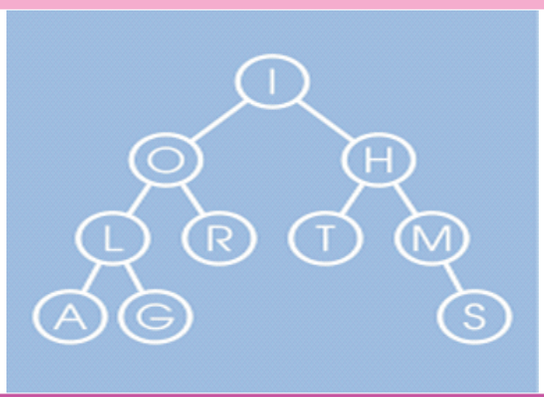
A LABORATORY MANUAL

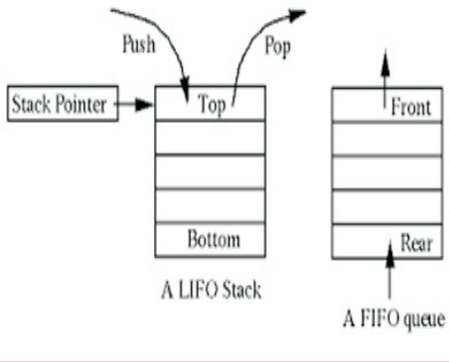
FOR

DATA STRUCTURE USING 'C'

(22317)







MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

(Autonomous) (ISO 9001 : 2015) (ISO / IEC 27001 : 2013)

VISION

To ensure that the Diploma level Technical Education constantly matches the latest requirements of technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the changing technological and environmental challenges.

QUALITY POLICY

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

CORE VALUES

MSBTE believes in the followings:

- Education industry produces live products.
- Market requirements do not wait for curriculum changes.
- Question paper is the reflector of academic standards of educational organization.
- Well designed curriculum needs effective implementation too.
- Competency based curriculum is the backbone of need based program.
- Technical skills do need support of life skills.
- Best teachers are the national assets.
- Effective teaching learning process is impossible without learning resources.

A Laboratory Manual

for

Data Structures Using 'C'

(22317)

Semester-III

(CO/CM/CW/IF)

Maharashtra State
Board of Technical Education, Mumbai
(Autonomous) (ISO:9001:2015) (ISO/IEC 27001:2013)

Maharashtra State Board of Technical Education,
(Autonomous) (ISO:9001:2015) (ISO/IEC 27001 : 2013)
4th Floor, Government Polytechnic Building, 49, Kherwadi,
Bandra (East), Mumbai - 400051.
(Printed on June, 2018)

MAHARASHTRA STATE

BOARD OF TECHNICAL EDUCATION

Certificate

This is to certify that Mr. / Ms. ……..…… Roll No. ……., of Third Semester of Diploma in ……..…… of Institute, ……..……..…. (Code: ……...) has completed the term work satisfactorily in course **Data Structures Using 'C' (22317)** for the academic year 20…….. to 20…….. as prescribed in the curriculum.

Place: …… Enrollment No:.……

Date: …… Exam. Seat No: ……

Subject Teacher **Head of the Department** **Principal**

Seal of Institution

Preface

The primary focus of any engineering laboratory/ field work in the technical education system is to develop the much needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'I' Scheme curricula for engineering diploma programmes with outcome-base education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher; instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a ***'vehicle'*** to develop this industry identified competency in every student. The practical skills are difficult to develop through 'chalk and duster' activity in the classroom situation. Accordingly, the 'I' scheme laboratory manual development team designed the practicals to ***focus*** on the ***outcomes***, rather than the traditional age old practice of conducting practicals to 'verify the theory' (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve as a key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

Data structure is an important aspect for Computer Engineering and Information Technology Diploma graduates. Data structure is a logical & mathematical model of storing & organizing data in a particular way in a computer. The methods and techniques of Data Structures are widely used in industries. After going through these learning experience students will be able to identify the problem, analyze different algorithms and use them to solve the problem.

Although best possible care has been taken to check for errors (if any) in this laboratory manual, perfection may elude us as this is the first edition of this manual. Any errors and suggestions for improvement are solicited and highly welcome

Programme Outcomes (POs) to be achieved through Practical of this Course:-

PO1. **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Computer engineering problem.

PO2. **Discipline knowledge:** Apply Information Technology knowledge to solve broad-based Information Technology related problems.

PO3. **Experiments and practice:** Plan to perform experiments, practices and to use the results to solve Information Technology related problems.

PO4. **Engineering tools:** Apply appropriate Information Technology related techniques/ tools with an understanding of the limitations.

PO7. **Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of Computer engineering.

PO8. **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

PO9. **Communication:**. Communicate effectively in oral and written form.

PO10. **Life-long learning:** Engage in independent and life-long learning activities in the context of technological changes in the Computer engineering field and allied industry.

Practical- Course Outcome matrix

Course Outcomes (COs)

a. Perform basic operations on arrays.
b. Apply different searching and sorting techniques.
c. Implement basic operations on stack and queue using array representation.
d. Implement basic operations on Linked List.
e. Implement program to create and traverse tree to solve problems.

S. No.	Practical Outcome	CO a.	CO b.	CO c.	CO d.	CO e.
1.	Program to perform operations on array	√	-	-	-	-
2.	Search a data using linear search	-	√	-	-	-
3.	Search a data using binary search	-	√	-	-	-
4.	Program to sort an array using bubble sort	-	√	-	-	-
5.	Program to sort an array using selection sort	-	√	-	-	-
6.	Program to sort an array using insertion sort	-	√	-	-	-
7.	Perform push and pop operations on stack	-	-	√	-	-
8.	Perform insert and delete operations on linear queue using array	-	-	√	-	-
9.	Perform insert and delete operations on circular queue using array	-	-	√	-	-
10.	Perform operation on singly linked list	-	-	-	√	-
11.	Perform operation on circular singly linked list	-	-	-	√	-
12.	Perform traversing on binary search tree	-	-	-	-	√

List of Industry Relevant Skills

The following industry relevant skills of the competency 'Implement relevant algorithms using Data Structures' are expected to be developed in you by undertaking the practical's of this laboratory manual.

1. Organize data in efficient manner
2. Use given data structure.
3. Apply sorting techniques on databases.

Guidelines to Teachers

1. There will be two sheets of blank pages after every practical for the student to report other matters(if any), which is not mentioned in the printed practicals.
2. For difficult practicals if required, teacher could provide the demonstration of the practical emphasizing of the skills which the student should achieve.
3. Teachers should give opportunity to students for hands-on after the demonstration.
4. Assess the skill achievement of the students and COs of each unit.
5. One or two questions ought to be added in each practical for different batches. For this teachers can maintain various practical related question bank for each course.
6. For effective implementation and attainment of practical outcomes, teacher ought to ensure that in the beginning itself of each practical, students must read through the complete write-up of that practical sheet.
7. During practical, ensure that each student gets chance and takes active part in taking observations/ readings and performing practical.
8. Teacher ought to assess the performance of students continuously according to the MSBTE guidelines.

Instructions for Students

1. For incidental writing on the day of each practical session every student should maintain a ***dated log book*** for the whole semester, apart from this laboratory manual which s/he has to ***submit for assessment to the teacher*** in the next practical session.
2. For effective implementation and attainment of practical outcomes, in the beginning itself of each practical, students need to read through the complete write-up including the practical related questions and assessment scheme of that practical sheet.
3. Student ought to refer the reference books, lab manuals, etc. Student should not hesitate to ask any difficulties they face during the conduct of practicals.

Content Page

List of Practical's and Progressive Assessment Sheet

Sr. No	Practical Outcome	Page No.	Date of performance	Date of submission	Assessment marks(25)	Dated sign. of teacher	Remarks (if any)
1.	Program to perform operations on array	1					
2.	Search a data using linear search	8					
3.	Search a data using binary search	16					
4.	Program to sort an array using bubble sort	24					
5.	Program to sort an array using selection sort	32					
6.	Program to sort an array using insertion sort	39					
7.	Perform push and pop operations on stack	46					
8.	Perform insert and delete operations on linear queue using array	54					
9.	Perform insert and delete operations on circular queue using array	62					
10.	Perform operation on singly linked list	71					
11.	Perform operation on circular singly linked list	78					
12.	Perform traversing on binary search tree	84					
Total							

- To be transferred to Proforma of CIAAN-2017.

Practical No. 1: Program to Perform Operations on Array

I. Practical Significance:

Arrays are used to implement other data structures, such as list, queues, stacks, strings, hash, etc. By using Array student should be able to create, insert, delete and display the contents from array.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the computer group related problems.
- **Discipline knowledge:** Apply Information Technology knowledge to solve broad-based Information Technology related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve the computer group related problems.
- **Engineering tools:** Apply relevant Computer programming / technologies and tools with an understanding of the limitations.
- **Communication:** Communicate effectively in oral and written form.

III. Competency and Practical skills

This practical expects to develop the following skills in the student.

Develop 'C' programs to solve computer group related problems.

1. Write algorithm and draw flow chart for Array.
2. Write/Compile/Debug and Save C program for operations on array.

IV. Relevant Course Outcome(s)

- Perform basic operations on array.

V. Practical Outcome (PrOs)

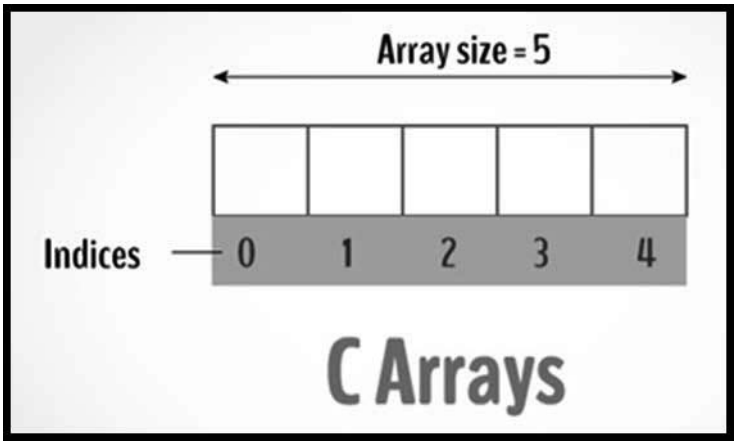
- Implement a 'C' program to perform following operations on Array :
  Creation, Insertion, Deletion, Display.

VI. Relevant Affective domain related Outcome(s)

1. Follow safety measures.
2. Follow ethical practices.

VII. Minimum Theoretical Background

Array:



An array is a collection of data that holds fixed number of values of same type. For example: if you want to store marks of 5 students, you can create an array for it.

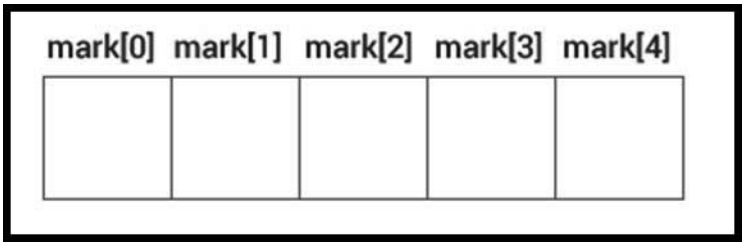
Declaration of an array in C:

Syntax: data_type array_name [array_size];

Ex. : int mark[5];

Array elements are accessed by indices.

Suppose an array *mark [5] declared* as above. The first element is *mark [0]*, second element is *mark [1]* and so on.



- Arrays have 0 as the first index not 1. In this example, *mark[0]*
- If the size of an array is *n*, then to access the last element, (n-1) index is used. In this example, *mark[4]*
- Suppose the starting address of mark [0] is 2120. Then, the next address, mark [1], will be 2122, address of mark [2] will be 2124 and so on. It's because the size of a int is 2 bytes.

VIII. Algorithm:

IX. Flowchart:

X. C Program Code:

XI. Resources required

Sr. No.	Name of Resource	Specification	Quantity	Remarks
1	Hardware: Computer System	Computer (i3-i5 preferable), RAM minimum 2 GB and onwards	As per batch size	For all Experiments
2	Operating system	Windows 7 or Later Version/LINUX version 5.0 or Later Version		
3	Software	Turbo C /C++ Version 3.0 or Later Version		

XII. Precautions

1. Array should be declared and accessed properly.
2. Save the program in specific directory / folder.
3. Follow safety practices.

XIII. Resources used

S. No.	Name of Resource	Specification
1	Computer System with broad specifications	
2	Software	
3	Any other resource used	

XIV. Results (Output of the Program)

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XV. Conclusion(s)

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XVI. Practical Related Questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identified CO.

1. Consider array size as 10. There are 8 elements in the array. The value (say 100) is to be inserted at index 9. What will be the output?
2. Consider array size as 10. There are 6 elements in the array. The value at index 7 is to be deleted. What will happen?

(Space for answers)

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XVII. Exercise

1. Perform the given operations on the following array and show diagrammatic presentation of each operation given below:

0	1	2	3	4	5	6	7	8	9	10
10	20	30	40	50	60	70	80	90		

   a) Delete element at index 8
   b) Add element at index 4 with value 999
   c) Delete element at index 0

2. Insert Array2 at index 2 of Array1 :

Array1:

0	1	2	3	4	5	6	7	8	9	10
10	20	30	40	50						

Array2:

0	1	2
100	200	300

(Space for answers)

XVIII. References / Suggestions for further Reading

1. https://www.tutorialspoint.com/cprogramming/c_arrays.htm (as on 17/01/2018)
2. https://youtube (as on 17/01/2018)

XIX. Assessment Scheme

Performance indicators		Weightage
Process related(10 Marks)		**30%**
1.	Debugging ability	20%
2.	Follow ethical practices.	10%
Product related (15 Marks)		**70%**
3.	Correctness of algorithm	15%
4.	Correctness of Program codes	25%
5.	Quality of input/output messaging and output formatting	20%
6.	Timely Submission of report	5%
7.	Answer to sample questions	5%
Total (25 Marks)		**100%**

List of Students /Team Members

1. ……..
2. ……..
3. ……..
4. …….

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total(25)**	

Practical No. 2: Search a Data Using Linear Search

I. Practical Significance

In order to perform some operation on specific data element, the data has to be searched in data collection, and the system requires following a searching method. One of the most commonly used method is linear search for searching data from the given list.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Computer engineering problem.
- **Discipline knowledge:** Apply Information Technology knowledge to solve broad-based Information Technology related problems.
- **Experiments and practice:** Plan to perform experiments, practices and to use the results to solve Information Technology related problems.
- **Engineering tools:** Apply appropriate Computer Engineering / Information Technology related techniques/ tools with an understanding of the limitations.
- **Communication:** Communicate effectively in oral and written form.

III. Competency and Practical skills

This practical is expect to develop the following skills in you

Develop 'C' programs to solve broad-based computer group related problems.

1. Write algorithm and draw Flow Chart for Linear Search.
2. Write/Compile/Debug and Save C program for function to search using Linear Search.

IV. Relevant Course Outcome(s)

- Apply different searching and sorting techniques.

V. Practical Outcome (PrOs)

Implement a 'C' program to search a particular data from the given Array using Linear Search.

VI. Relevant Affective domain related Outcome(s)

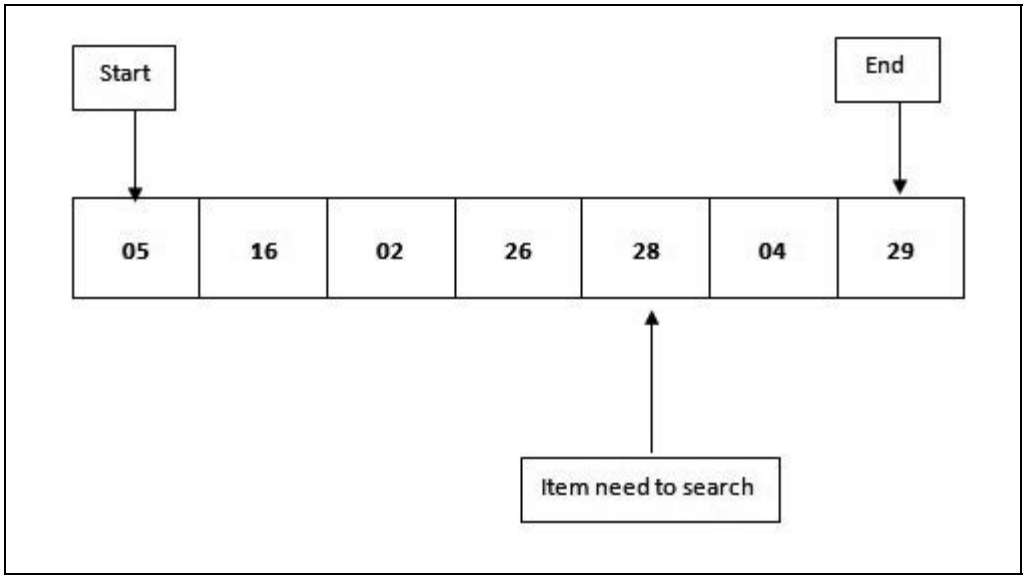
1. Follow safety measures
2. Follow ethical practices.

VII. Minimum Theoretical Background

Searching: Searching is just finding out the data item among given list. Two cases are possible that either item is found or item not present in the list.

Linear search: Linear Search is a very simple search algorithm. In this sequential search is done by searching items one by one. Each item is checked and if a match is found then that particular item is returned, otherwise the search is continues till end of

the list of items. If item which is to be searched is not present in list then the search is called as unsuccessful search.



VIII. Algorithm

IX. Flow Chart

X. ‘C’ Program Code

XI. Resources required

Sr. No.	Name of Resource	Specification	Quantity	Remarks
1	Hardware: Computer System	Computer (i3-i5 preferable), RAM minimum 2 GB onwards	As per batch size	For all Experiments
2	Operating system	Windows 7 or Later Version/LINUX version 5.0 or Later Version		
3	Software	Turbo C /C++ Version 3.0 or Later Version		

XII. Precautions

1. Save the program in specific directory / folder.
2. Follow safety practices.

XIII Resources used

S. No.	Name of Resource	Specification
1	Computer System with broad specifications	
2	Software	
3	Any other resource used	

XIV Result (Output of the Program)

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XV Conclusion(s)

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XVI Practical Related Questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identified CO.

1. Linear Search is most suitable for which kind of data list?
2. What is the output if list of item having same data item which is to be searched?

(Space for answers)

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XVII Exercise

1. Consider following list to perform Linear Search.
   56, 36, 89, 56, 01,00,67,59
   i. Search the item 01 from above list and write the item is found or not with procedure.
   ii. Search the item 55 from above list. Write the item is found or not with procedure.
2. State the limitations of Linear Search in terms of Time Complexity.

(Space for answers)

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XVIII References / Suggestions for further Reading

1. https://www.tutorialspoint.com/data_structures_algorithms/linear_search_algorithm.htm (as on 17/1/2018)
2. https://www.youtube.com/watch?v=hi-lwJRQ1-s
3. https://www.youtube.com/watch?v=iwo5WAldDks

XIX Assessment Scheme

Performance indicators		Weightage
Process related(10 Marks)		**30%**
1	Debugging ability	20%
2	Follow ethical practices.	10%
Product related (15 Marks)		**70%**
3	Correctness of algorithm	15%
4	Correctness of Program codes	25%
5	Quality of input/output messaging and output formatting	20%
6	Timely Submission of report	5%
7	Answer to sample questions	5%
Total (25 Marks)		**100%**

List of Students /Team Members

1. ……..
2. ……..
3. ……..
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total(25)**	

Practical No. 3: Search a data using binary search

I. Practical Significance

In order to perform some operation on specific data element, the data has to be searched in data collection, and the system requires following a searching method. One of the most commonly used methods is Binary search for searching data from the given list. Binary Search is suitable of large scale of data.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Computer engineering problem.
- **Discipline knowledge:** Apply Information Technology knowledge to solve broad- based Information Technology related problems.
- **Experiments and practice:** Plan to perform experiments, practices and to use the results to solve Information Technology related problems.
- **Engineering tools:** Apply appropriate Computer Engineering / Information Technology related techniques/ tools with an understanding of the limitations.
- **Communication:** Communicate effectively in oral and written form.

III. Competency and Practical skills

This practical is expect to develop the following skills in student.

Develop 'C' programs to solve broad-based computer group related problems.

1. Write algorithm and draw Flow Chart for Binary Search.
2. Write/Compile/Debug and Save C program for function to search using Binary Search.

IV. Relevant Course Outcome(s)

- Apply different searching and sorting techniques.

V. Practical Outcome (POs)

Implement a 'C' program to search a particular data from the given Array using Binary Search

VI. Relevant Affective domain related Outcome(s)

1. Follow safety measures
2. Follow ethical practices.

VII. Minimum Theoretical Background

Searching: Searching is, finding out the data item among list given. Two cases are possible that either item is found or item not present in the list.

Binary Search: Binary Search is a useful and fast search algorithm. This searching method uses divide and conquer principal. Binary search uses sorted list to search an item.

Binary Search looks for a particular item by comparing the middle most item of the collection. If match occurs then the index of item is returned. If middle item is greater than the item, the item is searched in the sub-array to the left of the middle item. Otherwise, the item is searched for in the sub-array to the right array as well until the size of the sub-array reduces to zero.

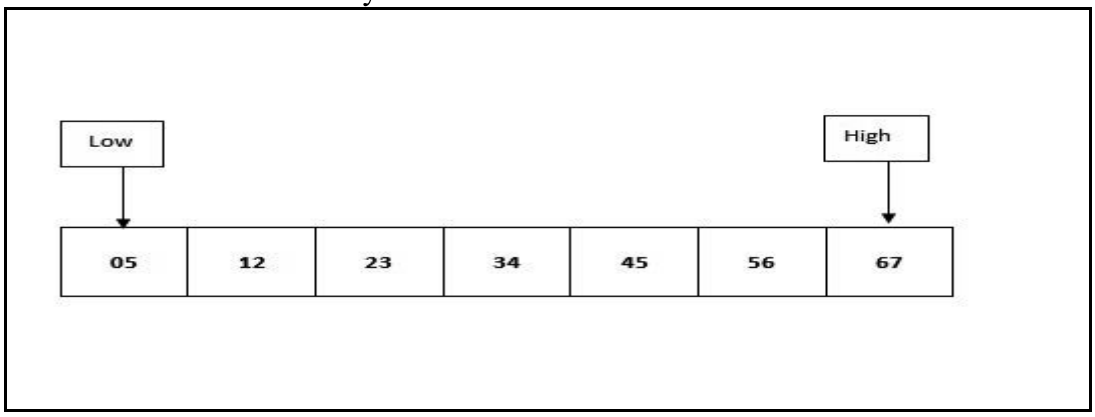

Fig 1.: Sorted array for searching an item

First determine half of the array by using this formula-

Mid=low + (high-low) /2

Here it is, 0+ (6-0)/2= 3. So, 3 is the Mid of the array.

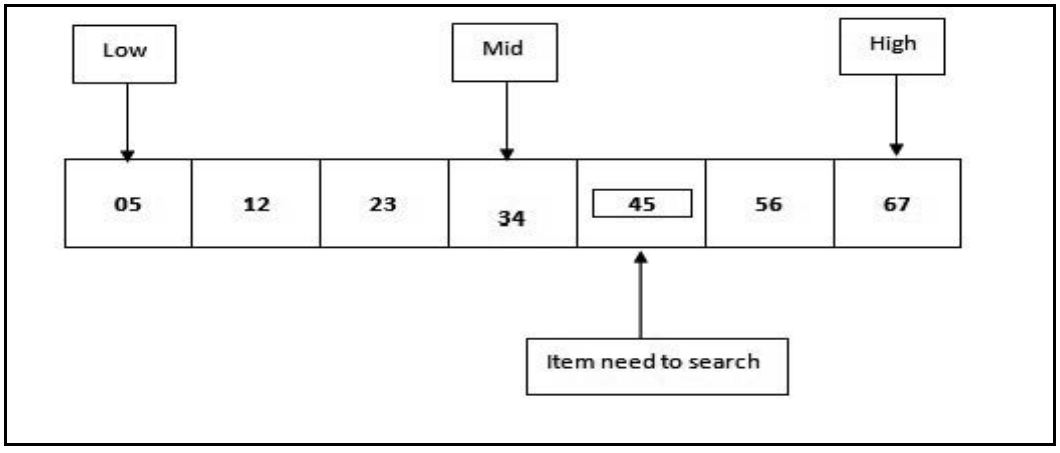

Fig 2.: Finding out the mid

Now we compare the value stored at location 3, with the value being searched, i.e.45. We find that the value at location 3 is 34, which is not a match. As the value is than greater 34 and we have a sorted array, so we also know that the target value must be in the upper portion of the array.

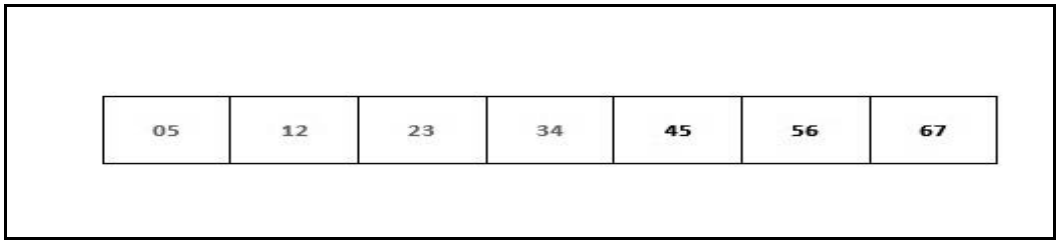

Fig 3. Upper portion of the array

We change our low to mid+1 and find the new mid value again

Low=mid+1

Mid=low + (high-low) /2

Do above given procedure till the item is found if present in the list.

VIII. Algorithm

IX. Flow Chart

X. ‘C’ Program Code

XI. Resources required

Sr. No.	Name of Resource	Specification	Quantity	Remarks
1	Hardware: Computer System	Computer (i3-i5 preferable), RAM minimum 2 GB and onwards	As per batch size	For all Experiments
2	Operating system	Windows 7 or Later Version/LINUX version 5.0 or Later Version		
3	Software	Turbo C /C++ Version 3.0 or Later Version		

XII Precautions

1. Save the program in specific directory / folder.
2. Follow safety practices.

XIII Resources used

S. No.	Name of Resource	Specification
1	Computer System with broad specifications	
2	Software	
3	Any other resource used	

XIV Result (Output of the Program)

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XV Conclusion(s)

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XVI Practical Related Questions

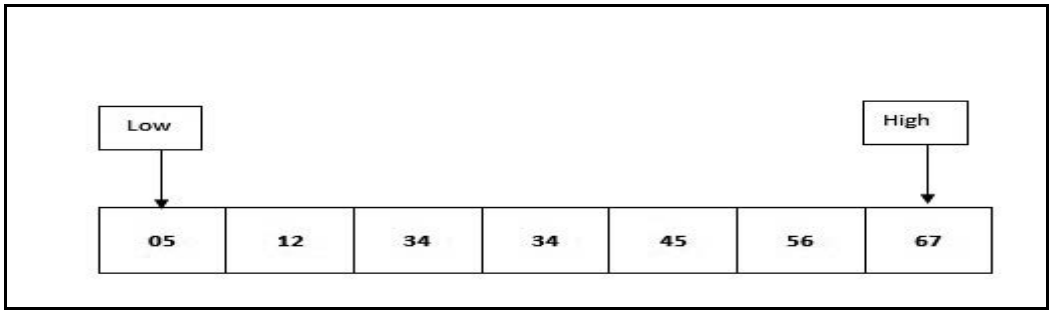
Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identified CO.

1. Binary Search is most suitable for what kind of data list.
2. If mid=4.5 then what should be the value of mid?

(Space for answers)

XVII Exercise

1. State the benefits and limitations of Binary Search in terms of Time Complexity.
2. Consider a following list and write down the steps to perform Binary Search to search following numbers.
   i. 12
   ii. 67
   iii. 100



(Space for answers)

XVIII References / Suggestions for further Reading

1. https://www.tutorialspoint.com/data_structures_algorithms/linear_search_algorithm.htm
2. https://www.youtube.com/watch?v=P3YID7liBug
3. https://www.youtube.com/watch?v=UeUyTbtFxQQ

XIX Assessment Scheme

Performance indicators		Weightage
Process related(10 Marks)		**30%**
1	Debugging ability	20%
2	Follow ethical practices.	10%
Product related (15 Marks)		**70%**
3	Correctness of algorithm	15%
4	Correctness of Program codes	25%
5	Quality of input/output messaging and output formatting	20%
6	Timely Submission of report	5%
7	Answer to sample questions	5%
Total (25 Marks)		**100%**

List of Students /Team Members

1. …….
2. ……
3. …….
4. …….

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total(25)**	

Practical No. 4: Program to Sort an Array Using Bubble Sort

I. Practical Significance:

In order to perform some operation on specific data element, the data has to be sorted in data collection, and the system requires following a Sorting method. One of the most commonly used methods is Bubble Sort for sorting data from the given list.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the computer group related problems.
- **Discipline knowledge:** Apply Information Technology knowledge to solve broad-based Information Technology related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve the computer group related problems.
- **Engineering tools:** Apply relevant Computer programming / technologies and tools with an understanding of the limitations.
- **Communication:** Communicate effectively in oral and written form.

III. Competency and Practical skills

This practical expects to develop the following skills in the student.

Develop 'C' programs to solve computer group related problems.

1. Write algorithm and draw flow chart for Bubble sort.
2. Write / Compile / Debug and execute 'C' program for Bubble sort.

IV. Relevant Course Outcome(s)

- Apply different searching and sorting techniques.

V. Practical Outcome (PrOs)

- Implement a 'C' program to sort an array using Bubble Sort method.

VI. Relevant Affective domain related Outcome(s)

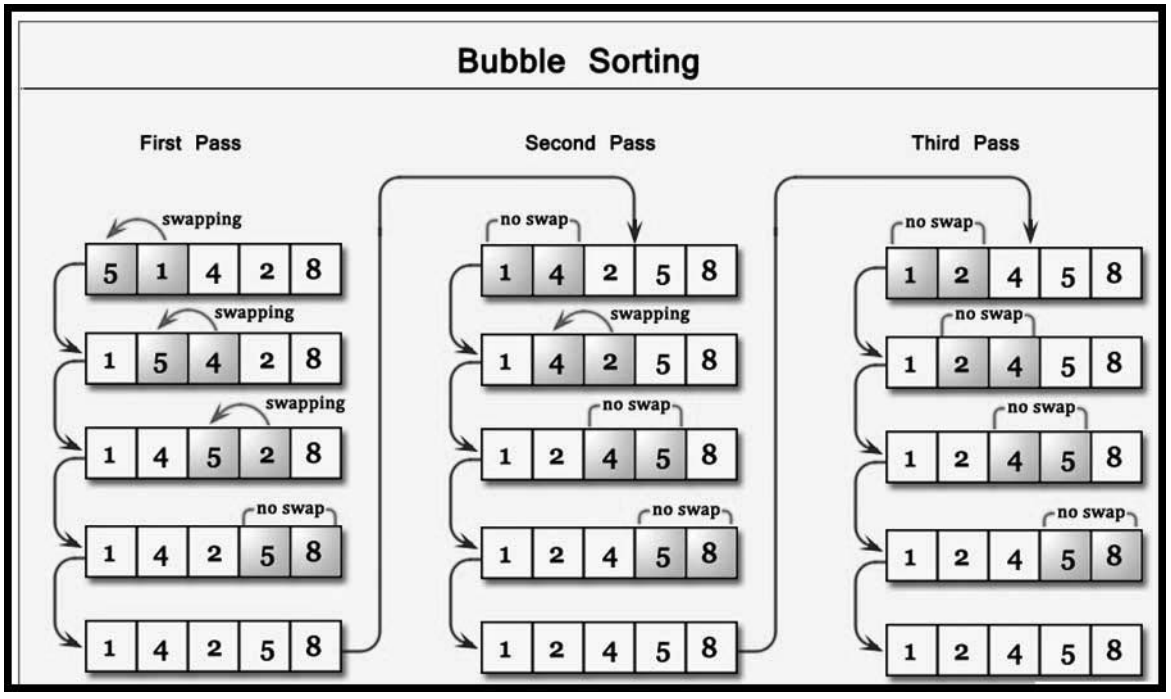
1. Follow safety measures.
2. Follow ethical practices.

VII. Minimum Theoretical Background

In Bubble Sort method the list is rearranged by exchanging the two adjacent elements if they are not in order (order may be ascending or descending).

Bubble sort algorithm starts by comparing the first two elements of an array and swapping if necessary, i.e., if you want to sort the elements of array in ascending order and if the first element is greater than second then, the elements are swapped but, if the first element is smaller than second, elements are not swapped. Then, again second and third elements are compared and swapped if it is necessary and this process continues until last and second last element are compared and swapped. This completes the first iteration of bubble sort.

In general it may be required to go through maximum passes as (N-1) for every pass the number of comparisons are (N-1), (N-2), (N-3),…., 1. The maximum number of comparisons are N(N-1) / 2.



VIII. Algorithm:

IX. Flowchart:

X. C Program Code:

XI. Resources required

Sr. No.	Name of Resource	Specification	Quantity	Remarks
1	Hardware: Computer System	Computer (i3-i5 preferable), RAM minimum 2 GB and onwards	As per batch size	For all Experiments
2	Operating system	Windows 7 or Later Version/LINUX version 5.0 or Later Version		
3	Software	Turbo C /C++ Version 3.0 or Later Version		

XII. Precautions

1. Save the program in specific directory / folder.
2. Follow safety practices.

XIII. Resources used

S. No.	Name of Resource	Specification
1	Computer System with broad specifications	
2	Software	
3	Any other resource used	

XIV. Results (Output of the Program)

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XV. Conclusion(s)

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XVI. Practical Related Questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identified CO.

1. What is the output of following code?

```
for(i=0;i<=n-1;i++)
{
for(j=0;j<=n-1-i;j++)
{
  if(a[j]>a[j+1])
  {
    temp=a[j];
    a[j]=a[j+1];
    a[j+1]=temp;
  }
  }
}
```

2. Find the error(s) (if any) from the following code :

```
 for (i=0;i<=n-1;i++)
  {
 for(j=1;j<n-1-i;j++)
  {
    if(a[i]>a[j])
    temp=a[j];
      a[j]=a[j+1];
      a[j+1]=temp;
    }
  }
```

(Space for answers)

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XVII. Exercise

1. Find the number of comparisons required in Bubble Sort of the following list having 5 numbers.

0	1	2	3	4
10	20	30	40	50

2. Sort the given array in ascending order using Bubble Sort method and show diagrammatic representation of every iteration of for loop.

0	1	2	3	4
1000	- 20	300	140	50

3. Sort the given array in ascending order using Bubble Sort method and show diagrammatic representation of every iteration of while loop.

0	1	2	3	4
500	120	2000	-210	89

(Space for answers)

XVIII. References / Suggestions for further Reading

1. https://www.w3resource.com/c-programming-exercises/searching-and-sorting/c- search-and-sorting-exercise-3.php (as on 17/01/2018).
2. https://www.sitesbay.com/data-structure/c-bubble-sort (as on 17/01/2018).
3. https://www.programiz.com/dsa/bubble-sort (as on 17/01/2018).
4. https://www.codingbot.net/2013/01/bubble-sort-algorithm-and-c-code.html (as on 17/01/2018).
5. https://www.youtube.com/watch?v=y_Nuui4Qf-k (as on 19/01/2018)

XIX. Assessment Scheme

Performance indicators		Weightage
Process related(10 Marks)		**30%**
1	Debugging ability	20%
2	Follow ethical practices.	10%
Product related (15 Marks)		**70%**
3	Correctness of algorithm	15%
4	Correctness of Program codes	25%
5	Quality of input/output messaging and output formatting	25%
6	Timely Submission of report	5%
7	Answer to sample questions	5%
Total (25 Marks)		**100%**

List of Students /Team Members

1. ……
2. ……
3. …….
4. ……..

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total(25)**	

Practical No. 5: Program to sort an array using selection sort

I. Practical Significance:

In order to perform some operation on specific data element, the data has to be sorted in data collection, and the system requires following a Sorting method. One of the most commonly used methods is Selection Sort for sorting data from the given list.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the computer group related problems.
- **Discipline knowledge:** Apply Information Technology knowledge to solve broad-based Information Technology related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve the computer group related problems.
- **Engineering tools:** Apply relevant Computer programming / technologies and tools with an understanding of the limitations.
- **Communication:** Communicate effectively in oral and written form.

III. Competency and Practical skills

This practical expects to develop the following skills in the student.

Develop 'C' programs to solve computer group related problems.

1. Write algorithm and draw flow chart for selection sort.
2. Write / Compile / Debug and execute 'C' program for Selection sort.

IV. Relevant Course Outcome(s)

- Apply different searching and sorting techniques.

V. Practical Outcome (PrOs)

- Implement a 'C' program to sort an array using Selection Sort method.

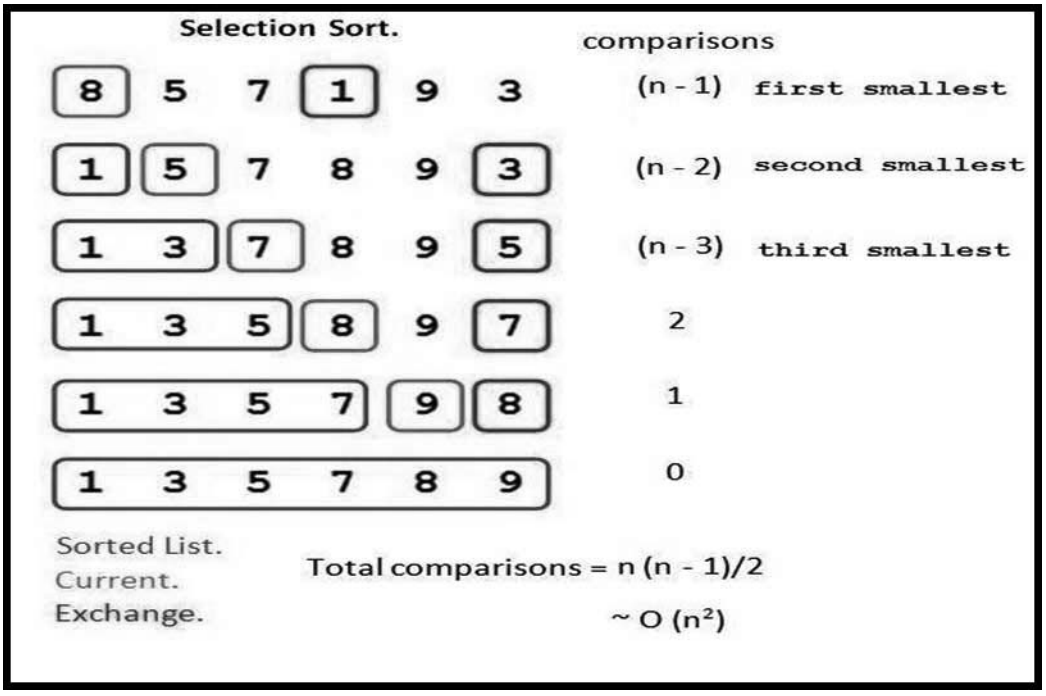
VI. Relevant Affective domain related Outcome(s)

1. Follow safety measures.
2. Follow ethical practices.

VII. Minimum Theoretical Background

Selection sort is similar to the hand picking where we take the smallest element and put it in the first position and the second smallest at the second position and so on.
We follow the following steps to perform selection sort:

1. Start from the first element in the array and search for the smallest element in the array.
2. Swap it with the value in the first position
3. Repeat the steps above for the remainder of the list (starting at the second position and Advancing each time)



VIII. Algorithm:

IX. Flowchart:

X. C Program Code:

XI. Resources required

Sr. No.	Name of Resource	Specification	Quantity	Remarks
1	Hardware: Computer System	Computer (i3-i5 preferable), RAM minimum 2 GB and onwards	As per batch size	For all Experiments
2	Operating system	Windows 7 or Later Version/LINUX version 5.0 or Later Version		
3	Software	Turbo C /C++ Version 3.0 or Later Version		

XII. Precautions

1. Save the program in specific directory / folder.
2. Follow safety practices.

XIII. Resources used

S. No.	Name of Resource	Specification
1	Computer System with broad specifications	
2	Software	
3	Any other resource used	

XIV. Results (Output of the Program)

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XV. Conclusion(s)

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XVI. Practical Related Questions

Note: Below given are few sample questions for reference. Teacher must design more such questions as to ensure the achievement of identified CO.

Choose the right option from the following:

1. A Selection Sort compares adjacent elements, and swaps them if they are in wrong order.
   a. True b. False c. Depends on Elements d. None of these
   Ans : _____

2. For each i from 1 to n-1, there are _ _ _ _ _ exchanges for Selection Sort:
   a. 1 b. n-1 c. n d. None of these
   Ans : _____

3. What is the output of selection sort after the 2nd iteration given the following sequence of numbers: 20 12 10 15 2
   a. 2 15 12 10 20
   b. 2 101 12 15 20
   c. 2 12 10 15 20
   d. None of the above
   Ans : _____

XVII. Exercise

1. Find the number of comparisons required in Selection Sort of the following given list having 5 numbers.

0	1	2	3	4
10	20	30	40	50

2. Sort the given array in ascending order using Selection Sort method and show diagrammatic representation of every iteration of for loop.

0	1	2	3	4
1000	- 20	300	140	50

3. Sort the given array in ascending order using Selection Sort method and show diagrammatic representation of every iteration of while loop.

0	1	2	3	4
500	120	2000	-210	89

(Space for answers)

XVIII. References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=Aq2E47uU2ao (as on 19/01/2018)
2. https://www.codesdope.com/blog/article/sorting-an-array-using-selection-sort-in-c/ (as on 18/01/2018)
3. https://stackoverflow.com (as on 18/01/2018)

XIX. Assessment Scheme

Performance indicators		Weightage
Process related(10 Marks)		**30%**
1	Debugging ability	20%
2	Follow ethical practices.	10%
Product related (15 Marks)		**70%**
3	Correctness of algorithm	15%
4	Correctness of Program codes	25%
5	Quality of input/output messaging and output formatting	25%
6	Timely Submission of report	5%
7	Answer to sample questions	5%
Total (25 Marks)		**100%**

List of Students /Team Members

1. ……..
2. ……..
3. ……..
4. ……..

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total(25)**	

Practical No. 6: Program to sort an array using insertion sort

I. Practical Significance:

In order to perform some operation on specific data element, the data has to be sorted in data collection, and the system requires following a Sorting method. One of the most commonly used methods is Insertion Sort for sorting data from the given list.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the computer group related problems.
- **Discipline knowledge:** Apply Information Technology knowledge to solve broad-based Information Technology related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve the computer group related problems.
- **Engineering tools:** Apply relevant Computer programming / technologies and tools with an understanding of the limitations.
- **Communication:** Communicate effectively in oral and written form.

III. Competency and Practical skills

This practical expects to develop the following skills in the student.

Develop 'C' programs to solve computer group related problems.

1. Write algorithm and draw flow chart for Insertion sort.
2. Write / Compile / Debug and execute ‘C’ program for Insertion sort.

IV. Relevant Course Outcome(s)

- Apply different searching and sorting techniques.

V. Practical Outcome (PrOs)

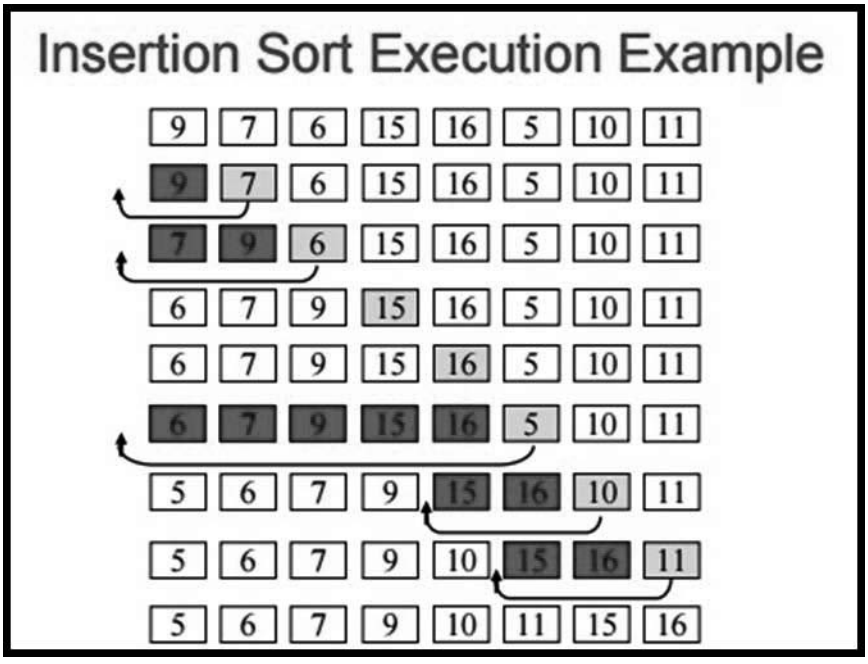
- Implement a ‘C’ program to sort an array using Insertion Sort method.

VI. Relevant Affective domain related Outcome(s)

1. Follow safety measures.
2. Follow ethical practices.

VII. Minimum Theoretical Background

Insertion Sort is a simplest data Sorting algorithm which sorts the array elements by shifting elements one by one and inserting each element into its proper position. Consider we sort playing cards in our hands.



VIII. Algorithm:

IX. Flowchart:

X. C Program Code:

XI. Resources required

Sr. No.	Name of Resource	Specification	Quantity	Remarks
1	Hardware: Computer System	Computer (i3-i5 preferable), RAM minimum 2 GB and onwards	As per batch size	For all Experiments
2	Operating system	Windows 7 or Later Version/LINUX version 5.0 or Later Version		
3	Software	Turbo C /C++ Version 3.0 or Later Version		

XII. Precautions

1. Save the program in specific directory / folder.
2. Follow safety practices.

XIII. Resources used

S. No.	Name of Resource	Specification
1	Computer System with broad specifications	
2	Software	
3	Any other resource used	

XIV. Results (Output of the Program)

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XV. Conclusion(s)

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XVI. Practical Related Questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identified CO.

1. Define insertion sort?

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2. Differentiate between bubble sort & insertion sort?

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Choose the right option from the following:-

3. Insertion sort is 1.in-place 2.out-place 3.stable 4.non-stable

   a.1 and 3 b.1 and 4 c.2 and 3 d.2 and 4

   Ans:_____

4. Sorting of playing cards is an example of

   a. Bubble sort b. Insertion sort c. Selection sort d. Quick sort

   Ans:_____

5. Total number of comparisons for insertion sort is
   a.n(n-1)/2
   b. n(n+1)/2
   c.n
   d.n*n
   Ans:_____

XVII. Exercise

1. Find the number of comparisons required in Insertion Sort of the following given list having 5 numbers.

0	1	2	3	4
10	20	30	40	50

2. Sort the given array in ascending order using Insertion Sort method and show diagrammatic representation of every iteration of for loop.

0	1	2	3	4
1000	- 20	300	140	50

3. What is the output of insertion sort after the 2nd iteration given the following sequence of numbers: 7 3 5 1 9 8 4 6

(Space for answers)

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XVIII. References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=OxN2Jqb8S9s (as on 19/01/2018)
2. https://stackoverflow.com (as on 18/01/2018)
3. https://www.sitesbay.com/data-structure/c-insertion-sort (as on 18/01/2018)
4. https://www.geeksforgeeks.org/insertion-sort/

XIX. Assessment Scheme

Performance indicators		Weightage
Process related(10 Marks)		**30%**
1	Debugging ability	20%
2	Follow ethical practices.	10%
Product related (15 Marks)		**70%**
3	Correctness of algorithm	15%
4	Correctness of Program codes	25%
5	Quality of input/output messaging and output formatting	25%
6	Timely Submission of report	5%
7	Answer to sample questions	5%
Total (25 Marks)		**100%**

List of Students /Team Members

1. ……..
2. ……..
3. ……..
4. ……..

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total(25)**	

Practical No. 7: Perform push and pop operations on stack

I. Practical Significance:

In order to perform insertion and deletion of data items from given data list based on Last in First out (LIFO) suitable data structure is required. So Stack is a data structure that follows the LIFO order and performs these operations from one end.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the computer group related problems.
- **Discipline knowledge:** Apply Information Technology knowledge to solve broad-based Information Technology related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve the computer group related problems.
- **Engineering tools:** Apply relevant Computer programming / technologies and tools with an understanding of the limitations.
- **Communication:** Communicate effectively in oral and written form.

III. Competency and Practical skills

This practical expects to develop the following skills in the student.

Develop 'C' programs to solve computer group related problems.

1. Write algorithm and draw flow chart of stack for push and pop operations.
2. Compile/Debug/Save the ‘C’ program.

IV. Relevant Course Outcome(s)

- Implement basic operations on stack and queue using array representation.

V. Practical Outcome (POs)

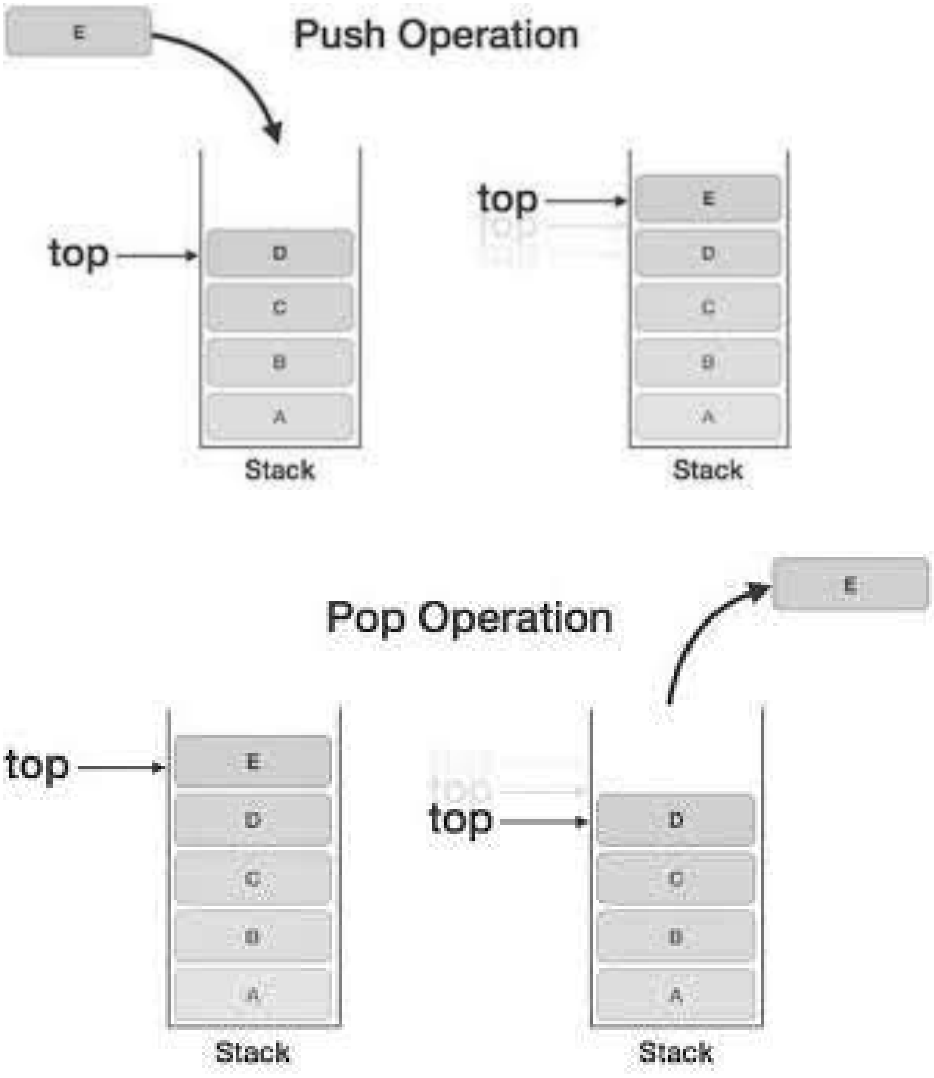
- Write ‘C’ program to perform PUSH and POP operations on stack array.

VI. Relevant Affective domain related Outcome(s)

1. Follow ethical practices.

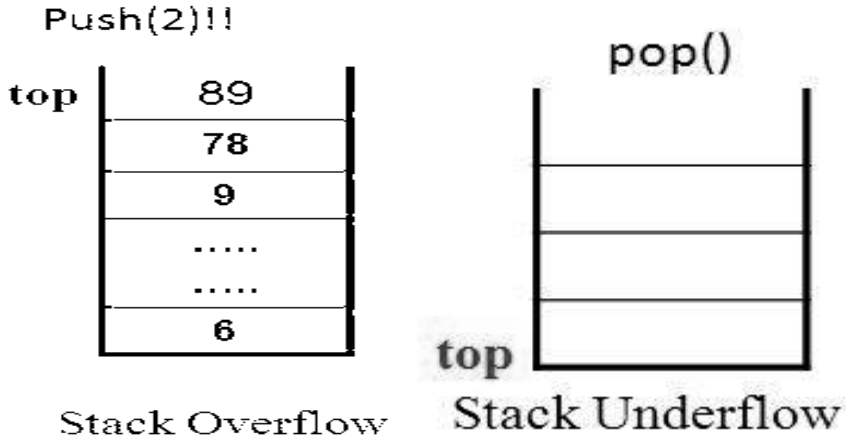
VII. Minimum Theoretical Background

A stack is a container of data items that are inserted and removed according to the last-in first-out (LIFO) principle. A stack has a restriction that insertion and deletion of element can only be done from only one end of stack and we call that position as **top**. The element at top position is called **top of the stack**. Insertion of element is called **PUSH** and deletion is called **POP**.



Overflow Condition: Happens when there is **no more space left** to store a **data item** that is **pushed.**

Underflow Condition: Happens when the **stack** is **empty** and the user executed a **POP** operation.



VIII. Algorithm

IX. Flowchart

X. C Program Code

XI. Resources required

Sr. No.	Name of Resource	Specification	Quantity	Remarks
1	Hardware: Computer System	Computer (i3-i5 preferable), RAM minimum 2 GB and onwards	As per batch size	For all Experiments
2	Operating system	Windows 7 or Later Version/LINUX version 5.0 or Later Version		
3	Software	Turbo C /C++ Version 3.0, or later , gcc compiler		

XII. Precautions

1. Give proper max-size for stack
2. Programs should be saved in desired folders.

XIII. Resources used

S. No.	Name of Resource	Specification
1	Computer System with broad specifications	
2	Software	
3	Any other resource used	

XIV. Result (Output of the Program)

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XV. Conclusion(s)

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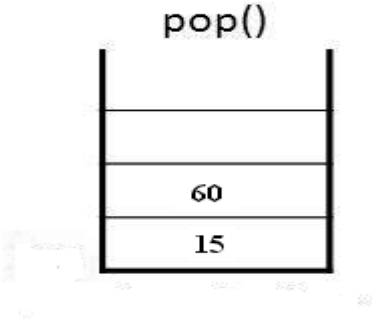
XVI. Practical Related Questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identified CO.

(Note: Programming exercise use blank pages provided or attach more pages if needed.)

1) Draw stack after POP operation using given below diagram.

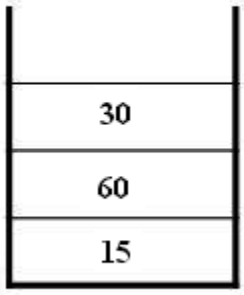


Ans:

2) Draw stack after PUSH operation using given stack

PUSH(45)

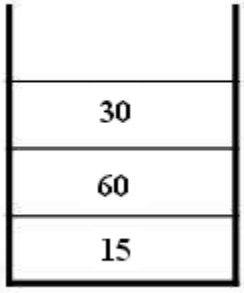
Ans



3) Write a TOP value after PUSH operation.

PUSH(45)

Ans



XVII. Exercise

(Note: Programming exercise use blank pages provided or attach more pages if needed.)

1) Perform following operation on stack of size 5.
   PUSH(30)
   PUSH(12)
   PUSH(10)
   POP()
   PUSH(45)
   POP(70)

2) Implement a "C" program to stack size-8 for push(10), push(20), pop, push(10), push(20), pop, pop, pop, push(20), pop and draw final output.

3) Perform following operation on stack of size 5.
   PUSH(100)
   PUSH(120)
   PUSH(50)
   POP()
   POP()
   POP(70)

(Space for answers)

XVIII. References / Suggestions for further Reading

1. www.geeksforgeeks.org/implement-two-stacks-in-an-array (as on 18/01/2018)
2. www.programmingunit.com/2013/01/14/stack-using-array-c-program **(** as on 18/01/2018)

XIX. Assessment Scheme

Performance indicators		Weightage
Process related(10 Marks)		**30%**
1	Debugging ability	20%
2	Follow ethical practices.	10%
Product related (15 Marks)		**70%**
3	Correctness of algorithm	15%
4	Correctness of Flow chart	15%
5	Correctness of Program codes	20%
6	Quality of input/output messaging and output formatting	5%
7	Timely Submission of report	5%
8	Answer to sample questions	10%
Total (25 Marks)		**100%**

List of Students /Team Members

1. ……..
2. ……..
3. …….
4. …….

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total(25)**	

Practical No. 8: Perform insert and delete operations on linear queue using array

I. Practical Significance:

In order to perform INSERT and DELETE operations from two ends on given list based on First in First out (FIFO) order. Linear Queue is collection of elements that follows the FIFO order which keep track of two indices, front and rear one for Insert and another for Delete.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the computer group related problems.
- **Discipline knowledge:** Apply Information Technology knowledge to solve broad-based Information Technology related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve the computer group related problems.
- **Engineering tools:** Apply relevant Computer programming / technologies and tools with an understanding of the limitations.
- **Communication:** Communicate effectively in oral and written form.

III. Competency and Practical skills

This practical expects to develop the following skills in the student.

Develop 'C' programs to solve computer group related problems.

1. Write algorithm and draw flow chart of linear queue for Insert and Delete operations.
2. Compile/Debug/ save the 'C' program.

IV. Relevant Course Outcome(s)

- Implement basic operations on stack and queue using array representation.

V. Practical Outcome (PrOs)

- Write 'C' program to perform INSERT and DELETE operations on linear queue using Array Part-I and II.

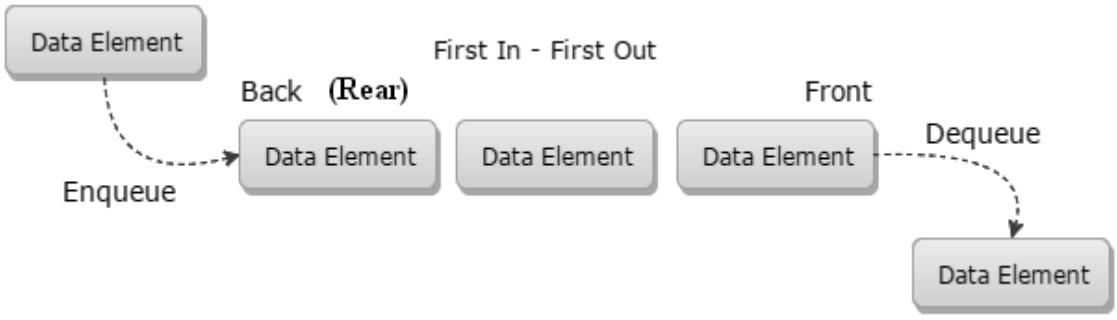
VI. Relevant Affective domain related Outcome(s)

1. Follow ethical practices.

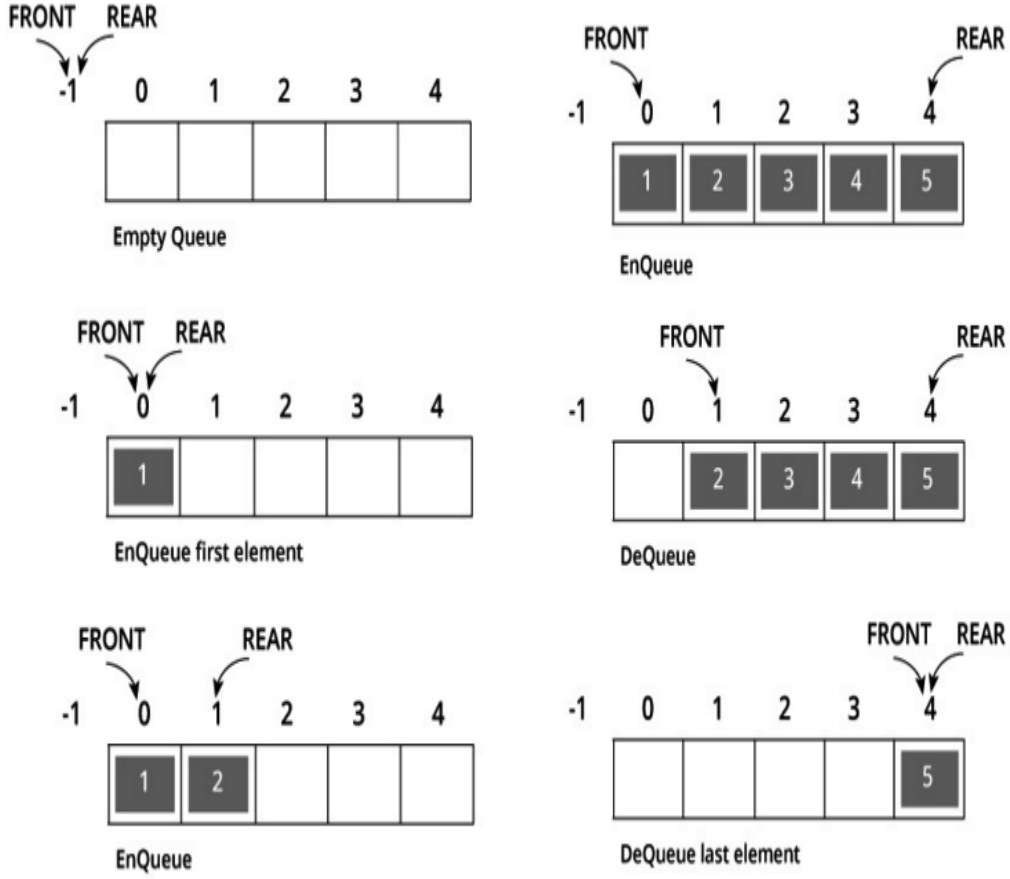
VII. Minimum Theoretical Background

A queue is a linear list of elements in which deletion of an element can take place only at one end called the front and insertion can take place on the other end which is termed as rear. The term front and rear are used frequently while describing queues in a linked list. In a queue the first item inserted is the first to be removed (First-In-First-

Out, FIFO). A queue has two pointers front and rear, pointing to the front and rear elements of the queue, respectively. This is a linear list DATA STRUCTURE used to represent a linear list and permits deletion to be performed at one end of the list and the insertion at the other end.



STEP BY STEP PROCESS IN LINEAR QUEUE:



VIII. Algorithm

IX. Flowchart

X. C Program Code

XI. Resources required

Sr. No.	Name of Resource	Specification	Quantity	Remarks
1	Hardware: Computer System	Computer (i3-i5 preferable), RAM minimum 2 GB and onwards	As per batch size	For all Experiments
2	Operating system	Windows 7 or Later Version/LINUX version 5.0 or Later Version		
3	Software	Turbo C /C++ Version 3.0, or later , gcc compiler		

XII. Precautions

1. Programs should be save in desired location.

XIII. Resources used

S. No.	Name of Resource	Specification
1	Computer System with broad specifications	
2	Software	
3	Any other resource used	

XIV. Result (Output of the Program)

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XV. Conclusion(s)

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XVI. Practical Related Questions

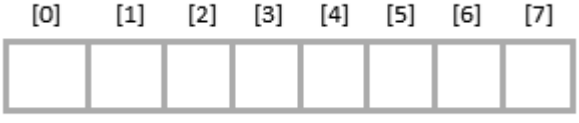
Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identified CO.

(Note: Programming exercise use blank pages provided or attach more pages if needed.)

1) Write a front and rear values of linear queue.

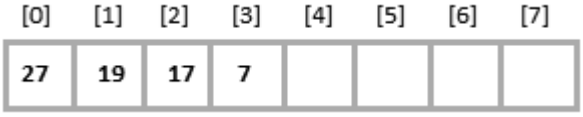
Ans:-

2) Sketch the front and rear in empty queue.



Ans:-

3) Sketch the front and rear in this queue.



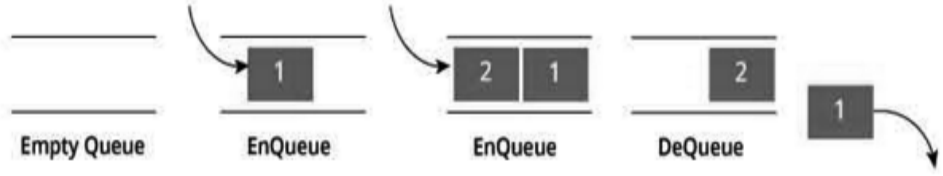
Ans:-

(**Space for Answer**)

XVII. Exercise

(Note: Programming exercise use blank pages provided or attach more pages if needed.)

1) Implement a C program to Linear queue in array size 5 with this operations INSERT(25), INSERT(55), INSERT(14), DELETE, DELETE, INSERT(40).
2) Implement a C program to Linear queue in array size 10 with this operations INSERT(10), INSERT(40), DELETE, INSERT(40), INSERT(20), DELETE, INSERT(40).
3) Write a 'c' program for linear queue using array from given data.



(Attach separate pages for answers)

XVIII. References / Suggestions for further Reading

1 www.uobabylon.edu.iq/eprints/publication_5_3108_1456.pdf(as on 18/01/2018)
2 www.w3schools.in/data-structures-tutorial/queue/ (as on 18/01/2018)

XIX. Assessment Scheme

Performance indicators		Weightage
Process related(10 Marks)		**30%**
1	Debugging ability	20%
2	Follow ethical practices.	10%
Product related (15 Marks)		**70%**
3	Correctness of algorithm	15%
4	Correctness of Program codes	25%
5	Quality of input/output messaging and output formatting	20%
6	Timely Submission of report	5%
7	Answer to sample questions	5%
Total (25 Marks)		**100%**

List of Students /Team Members

1. ……..
2. ……..
3. ……..
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total(25)**	

Practical No. 9: Perform insert and delete operations on circular queue using array

I. Practical Significance:

In order to perform INSERT and DELETE operations from two ends on given list based on First in First out (FIFO) order. But in Linear queue deleted item's location is wasted because another data item cannot occupy that location. So to overcome this Circular Queue can be the feasible option.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the computer group related problems.
- **Discipline knowledge:** Apply Information Technology knowledge to solve broad-based Information Technology related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve the computer group related problems.
- **Engineering tools:** Apply relevant Computer programming / technologies and tools with an understanding of the limitations.
- **Communication:** Communicate effectively in oral and written form.

III. Competency and Practical skills

This practical expects to develop the following skills in the student.

Develop 'C' programs to solve computer group related problems.

1. Write algorithm and draw flow chart of circular queue for Insert and Delete operations.
2. Compile/Debug/ Save the 'C' program.

IV. Relevant Course Outcome(s)

- Implement basic operations on stack and queue using array representation.

V. Practical Outcome (PrOs)

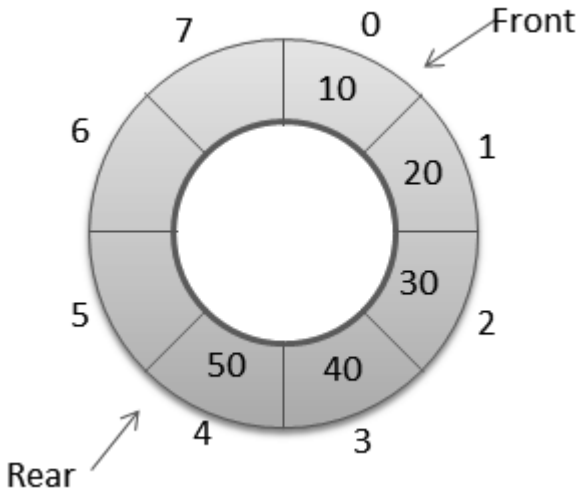
- Write 'C' program to perform INSERT and DELETE operations on circular queue using Array Part-I and II.

VI. Relevant Affective domain related Outcome(s)

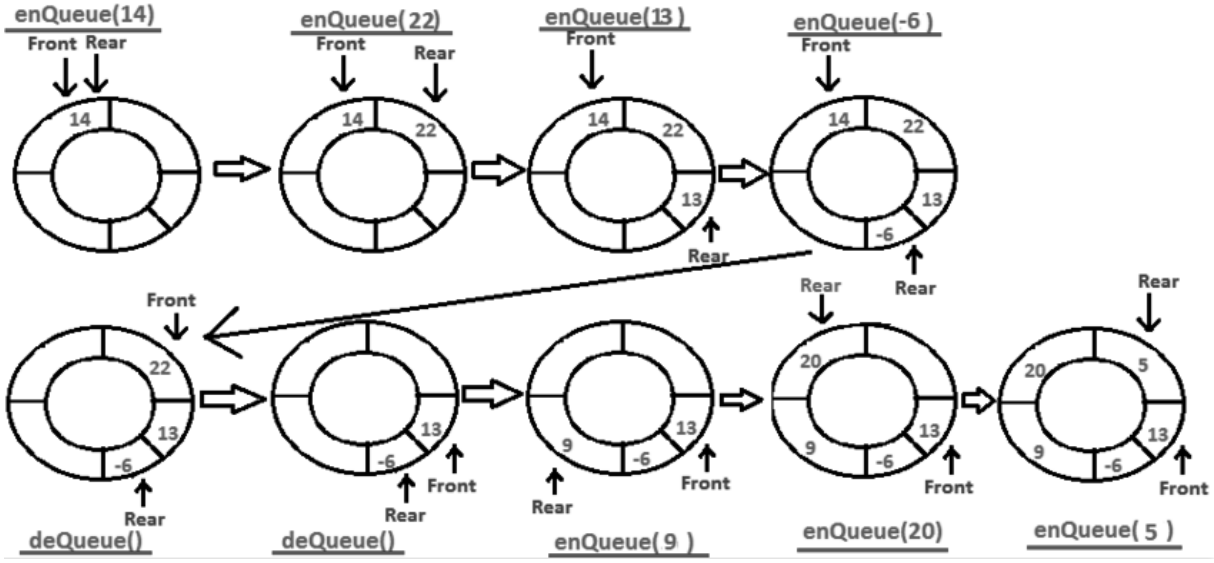
1. Follow ethical practices.
2. Follow Safety practices

VII. Minimum Theoretical Background

Circular queue is a linear data structure. It follows FIFO principle. In circular queue the last node is connected back to the first node to make a circle. Elements are added at the rear end and the elements are deleted at front end of the queue. Any position before front is also after rear. It is also called **'Ring Buffer'**.



STEP BY STEP PROCESS:



- **Front:** Get the front item from queue.
- **Rear:** Get the last item from queue.
- **enQueue (value)** This function is used to insert an element into the circular queue. In a circular queue, the new element is always inserted at Rear position.
- **deQueue()** This function is used to delete an element from the circular queue. In a circular queue, the element is always deleted from front position.

VIII. Algorithm

IX. Flowchart

X. C Program Code

XI. Resources required

Sr. No.	Name of Resource	Specification	Quantity	Remarks
1	Hardware: Computer System	Computer (i3-i5 preferable), RAM minimum 2 GB and onwards	As per batch size	For all Experiments
2	Operating system	Windows 7 or later Version/LINUX version 5.0 or later Version		
3	Software	Turbo C /C++ Version 3.0, or later , gcc compiler		

XII. Precautions

1. Save program in dedicated folder.

XIII. Resources used

S. No.	Name of Resource	Specification
1	Computer System with broad specifications	
2	Software	
3	Any other resource used	

XIV. Result (Output of the Program)

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XV. Conclusion(s)

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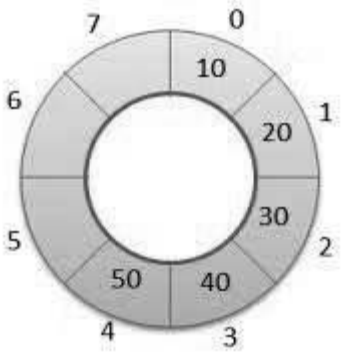
XVI. Practical Related Questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identified CO.

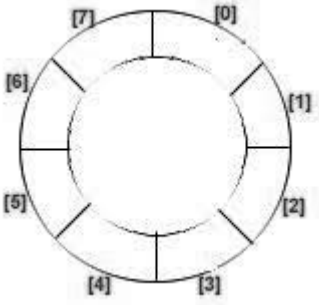
(Note: Programming exercise use blank pages provided or attach more pages if needed.)

1) Write a front and rear values of circular queue.



Ans:

2) Show the front and rear in empty circular queue.



Ans:

3) Show the circular queue using given values of array (size is 5).
15, 20, 30,10,5

Ans:-

(Space for Answer)

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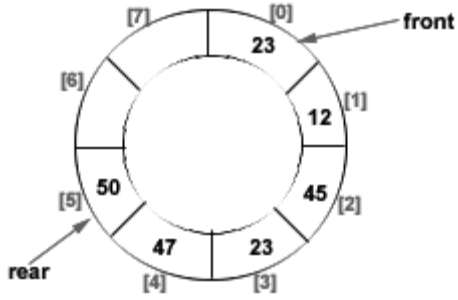
XVII. Exercise

Attempt Q1. and teacher shall allot Q. 2/Q.3 from the following:

(Note: Programming exercise use blank pages provided or attach more pages if needed.)

1) Implement a C program to circular queue in array size 5 with this operations INSERT(25), INSERT(55), INSERT(14), DELETE, DELETE, INSERT(40).
2) Implement a C program to circular queue in array size 10 with this operations INSERT(10), INSERT(40), DELETE, INSERT(40), INSERT(20), DELETE, INSERT(40).
3) Write a circular queue c program using array from given data.



(Attach separate pages for answers)

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XVIII. References / Suggestions for further Reading

1. www.geeksforgeeks.org/circular-queue-set-1-introduction-array-implementation/ (as on 18/01/2018)
2. www.programiz.com/dsa/circular-queue (as on 18/01/2018)

XIX. Assessment Scheme

Performance indicators		Weightage
Process related(10 Marks)		**30%**
1	Debugging ability	20%
2	Follow ethical practices.	10%
Product related (15 Marks)		**70%**
3	Correctness of algorithm	15%
4	Correctness of Program codes	25%
5	Quality of input/output messaging and output formatting	20%
6	Timely Submission of report	5%
7	Answer to sample questions	5%
Total (25 Marks)		**100%**

List of Students /Team Members

1. ……..
2. ……..
3. ……..
4. …….

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total(25)**	

Practical No. 10: Perform operation on singly linked list

I. Practical Significance

In order to use and perform operations on dynamic memory allocation in application non-contiguous data structure is required. So linked list is a used to Organize data in non-contiguous form. This will save wastage of memory by using dynamic memory allocation.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Computer engineering problem.
- **Discipline knowledge:** Apply Information Technology knowledge to solve broad- based Information Technology related problems.
- **Experiments and practice:** Plan to perform experiments, practices and to use the results to solve Information Technology related problems.
- **Engineering tools:** Apply appropriate Computer Engineering / Information Technology related techniques/ tools with an understanding of the limitations.
- **Communication:** Communicate effectively in oral and written form.

III. Competency and Practical skills

This practical is expect to develop the following skills in student.

Develop 'C' programs to solve broad-based computer group related problems.

1. Write algorithm and draw Flow Chart for inserting and deleting nodes in singly linked list.
2. Write C program for inserting and deleting nodes in singly linked list.
3. Compile/Debug/Save the C program.

IV. Relevant Course Outcome(s)

- Implement basic operations on Linked List.

V. Practical Outcome

- Write C program to perform the operations(Insert, Delete, Traverse and Search) on singly linked list.

VI. Relevant Affective domain related Outcome(s)

1. Follow ethical practices.
2. Follow safety practices

VII. Minimum Theoretical Background

Linked List: Linked List data structure consists of collection of nodes in a sequence which is divided in two parts. Each node consists of its own data and the address of the next node and forms a chain. Linked Lists are used to create stacks, queues,trees and graphs.

Fig1. Node

Data holds the data variable while Next holds the address to the next Node in the list.

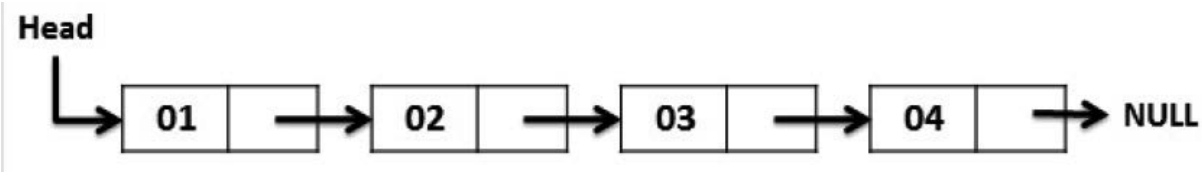

Fig 2. Linked List

Head is a pointer variable of type struct Node which acts as the Head(starting of a node) to the list. Initially we set 'Head' as NULL which means list is empty. Basically Single Linked Lists are uni-directional as they can only point to the next Node in the list but not to the previous. The operations we can perform on singly linked lists are insertion, deletion and traversal.

VIII. Algorithm (Attach separate paper if required)

1. Insert a node

i. At Beginning of Linked List
ii. At the end of Linked List
iii. At a given position in Linked List

2. Delete a node

i. At Beginning of Linked List
ii. At the end of Linked List
iii. At a given position in Linked List

3. Traversing Linked List

4. Searching data from Linked List

IX. Flow Chart (Attach separate paper if required)

X. ‘C’ Program Code(Attach separate paper if required

XI. Resources required

Sr. No.	Name of Resource	Specification	Quantity	Remarks
1	Hardware: Computer System	Computer (i3-i5 preferable), RAM minimum 2 GB and onwards	As per batch size	For all Experiments
2	Operating system	Windows 7 or Later Version/LINUX version 5.0 or Later Version		
3	Software	Turbo C /C++ Version 3.0 or later		

XII. Precautions

1. Be careful while giving input for dynamic memory allocation.
2. Follow pointer's fundamentals.

XIII. Resources used

S. No.	Name of Resource	Specification
1	Computer System with broad specifications	
2	Software	
3	Any other resource used	

XIV. Result

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XV. Conclusion(s)

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XVI. Practical Related Questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identified CO.

Choose right option for following:

1. Single linked list uses _ _ _ _ _ _ no. of pointers

   a. Zero **b.** one **c.** Two **d.** Three

2. No. of pointers to be manipulated in a linked list to insert an item in the middle _
   a. Two **b**. Three **c.** One **d**. Zero
3. Linked lists are not suitable for data structures of which one of the following problem?
   a. Insertion sort **b**. Binary search **c**. Radix sort **d**. Polynomial manipulation problem
4. The linked list field(s) are
   a. Data **b**. Pointer **c**. Pointer to next node **d**. Data and pointer to next node

(Space for Answer)

XVII. Exercise

1. Give syntax of creation of a node.
2. Represent Linked List as Stack and Queue.
3. Give the output of

```
void printList()
{
struct node *ptr = head;
printf("\n[ ");
//start from the beginning
while(ptr != NULL){
printf("(%d,%d) ",ptr->key,ptr->data);
ptr = ptr->next;}
printf(" ]");}
```

(Space for answers)

XVIII. References / Suggestions for further Reading

1. https://www.tutorialspoint.com/data_structures_algorithms/linked_list_algorithms.htm
2. https://www.youtube.com/watch?v=o1QaGUEi6ew
3. https://www.youtube.com/watch?v=e7xUBwxOzpk
4. https://www.youtube.com/watch?v=hAzTqg8jmWA

XIX. Assessment Scheme

Performance indicators		Weightage
Process related(10 Marks)		**30%**
1	Debugging ability	20%
2	Follow ethical practices.	10%
Product related (15 Marks)		**70%**
3	Correctness of algorithm	15%
4	Correctness of Program codes	25%
5	Quality of input/output messaging and output formatting	20%
6	Timely Submission of report	5%
7	Answer to sample questions	5%
Total (25 Marks)		**100%**

List of Students /Team Members

1. ……..
2. ……..
3. ……..
4. …….

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total(25)**	

Practical No. 11: Perform operation on circular singly linked list

I. Practical Significance

In some applications Dynamic memory allocation using simple singly Linked List may prone to storage wastage if data items are deleted. So simple singly Linked List can be used in circular manner. It gives the flexibility in storage management.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Computer engineering problem.
- **Discipline knowledge:** Apply Information Technology knowledge to solve broad- based Information Technology related problems.
- **Experiments and practice:** Plan to perform experiments, practices and to use the results to solve Information Technology related problems.
- **Engineering tools:** Apply appropriate Computer Engineering / Information Technology related techniques/ tools with an understanding of the limitations.
- **Communication:** Communicate effectively in oral and written form.

III. Competency and Practical skills

This practical is expect to develop the following skills in you

Develop 'C' programs to solve broad-based computer group related problems.

1. Write algorithm and draw Flow Chart for inserting and deleting nodes in circular singly linked list.
2. Write C program for inserting and deleting nodes in circular singly linked list.
3. Compile/Debug/ Save C program for inserting and deleting nodes in circular singly linked list.

IV. Relevant Course Outcome(s)

- Implement basic operations on Linked List.

V. Practical Outcome (PrOs)

- Write C program to perform the operations (Insert, Delete, Traverse and Search) on Circular singly linked list.

VI. Relevant Affective domain related Outcome(s)

1. Follow ethical practices.
2. Follow safety practices.

VII. Minimum Theoretical Background

Circular Linked List: Circular Linked List is a variation of Linked list in which the first element points to the last element and the last element points to the first element. Both Singly Linked List and Doubly Linked List can be made into a circular linked list.

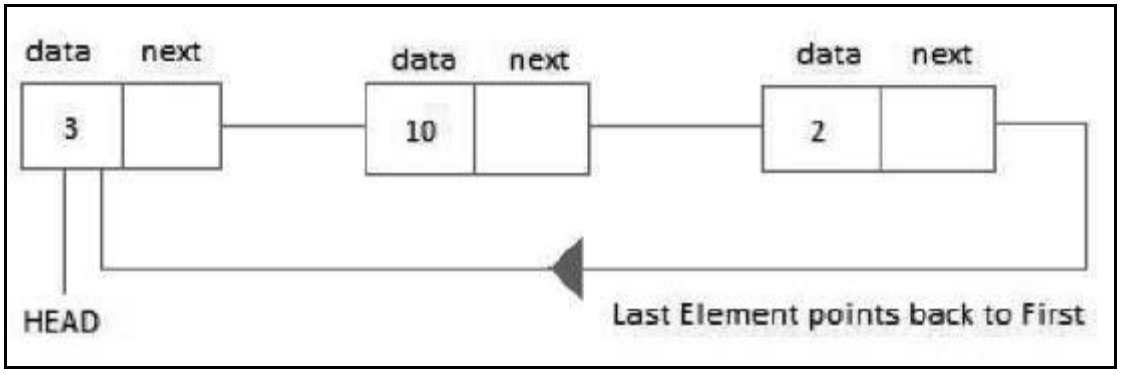

Fig 1.Circular Linked List

Head is a pointer variable of type struct Node which acts as the Head to the list. Initially Head is connected to last node of list. The operations we can perform on Circular singly linked lists are insertion, deletion and traversal.

VIII. Algorithm (Attach separate paper if required)

1. **Insert a node**
   iv. At Beginning of Linked List
   v. At the end of Linked List
   vi. At a given position in Linked List

2. **Delete a node**
   iv. At Beginning of Linked List
   v. At the end of Linked List
   vi. At a given position in Linked List

3. **Traversing Linked List**

4. **Searching data from Linked List**

IX. Flow Chart (Attach separate paper if required)

X. ‘C’ Program Code (Attach separate paper if required.)

XI. Resources required

Sr. No.	Name of Resource	Specification	Quantity	Remarks
1	Hardware: Computer System	Computer (i3-i5 preferable), RAM minimum 2 GB and onwards	As per batch size	For all Experiments
2	Operating system	Windows 7 or Later Version/LINUX version 5.0 or Later Version		
3	Software	Turbo C /C++ Version 3.0 or later		

XII. Precautions

1. Be careful while giving input for dynamic memory allocation.
2. Keep track of next pointer to observe Circular singly linked list.

XIII. Resources used

S. No.	Name of Resource	Specification
1	Computer System with broad specifications	
2	Software	
3	Any other resource used	

XIV. Result (Output of the Program)

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XV. Conclusion(s)

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XVI. Practical Related Questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identified CO.

Choose the right option from following:

1. Circular Single linked list uses _ _ _ _ _ _ no. of pointers

a. Zero **b.** one **c.** Two **d.** Three

2. No. of pointers to be manipulated in a Circular linked list to insert an item in the middle _ _
   a. Two **b.** Three **c.** One **d.** Zero
3. Linked lists are not suitable for data structures of which one of the following problem?
   a. insertion sort **b.** Binary search **c.** radix sort
   d. polynomial manipulation problem
4. The last node of Circular linked list field(s) having
   a. data **b.** pointer **c.** pointer to next node **d.** pointer to first node

XVII. Exercise

1. Give the benefit of Circular Single Linked List.
2. Represent Linked List as Circular Queue.

(Space for answers)

XVIII. References / Suggestions for further Reading

1. https://www.tutorialspoint.com/data_structures_algorithms/circular_linked_list_algorithm.htm
2. https://www.youtube.com/watch?v=I4tVBFBoNSA
3. https://www.youtube.com/watch?v=8pLwfW9Gov8
4. https://www.youtube.com/watch?v=xcF521FiHiM

XIX. Assessment Scheme

Performance indicators		Weightage
Process related(10 Marks)		**30%**
1	Debugging ability	20%
2	Follow ethical practices.	10%
Product related (15 Marks)		**70%**
3	Correctness of algorithm	15%
4	Correctness of Program codes	25%
5	Quality of input/output messaging and output formatting	20%
6	Timely Submission of report	5%
7	Answer to sample questions	5%
Total (25 Marks)		**100%**

List of Students /Team Members

1. ……..
2. ……..
3. ……..
4. …….

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total(25)**	

Practical No. 12: Perform traversing on binary search tree

I. Practical Significance

To perform operations in some application which works on hierarchical data a Tree data structure is most known Data structure. Tree is used to represent data in hierarchical manner. A binary tree can be used to represent ordered array and a linked list.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Computer engineering problem.
- **Discipline knowledge:** Apply Information Technology knowledge to solve broad-based Information Technology related problems.
- **Experiments and practice:** Plan to perform experiments, practices and to use the results to solve Information Technology related problems.
- **Engineering tools:** Apply appropriate Computer Engineering / Information Technology related techniques/ tools with an understanding of the limitations.
- **Communication:** Communicate effectively in oral and written form.

III. Competency and Practical skills

This practical is expect to develop the following skills in you

Develop 'C' programs to solve broad-based computer group related problems.

1. Write algorithm and draw Flow Chart for Traversing Tree.
2. Write a C program for Traversing Tree
3. Compile/Debug/Save the C program.

IV. Relevant Course Outcome(s)

- Implement program to create and traverse tree to solve problems.

V. Practical Outcome

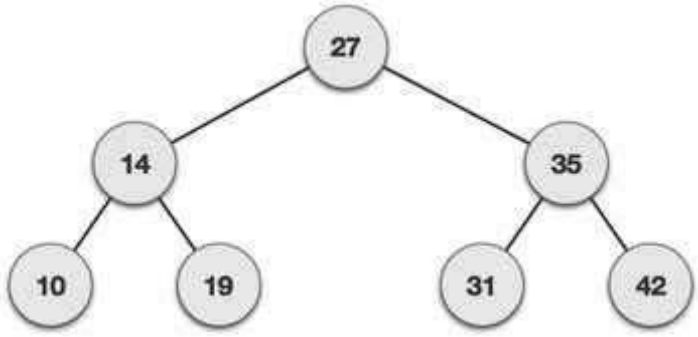
- Write C program to implement BST(Binary Search Tree) and traverse the tree (Inorder, Preorder, Postorder)

VI. Relevant Affective domain related Outcome(s)

1. Follow safety measures
2. Follow ethical practices.

VII. Minimum Theoretical Background

Binary Search Tree (BST) : A binary search tree is a tree where each node has a left and right child. Either child, or both children, may be missing. A node's left child must have a value less than its parent's value and the node's right child must have a value greater than its parent value.



Traversing : Unlike linear data structures (Array, Linked List, Queues, Stacks, etc) which have only one logical way to traverse them, trees can be traversed in different ways. Following are the generally used ways for traversing trees.

Tree Traversals:

(a) Inorder

(b) Preorder

(c) Postorder

VIII. Algorithm (Attach separate paper if required)

1. Create Binary Search Tree

2. Traversal

i. Inorder
ii. Preorder
iii. Postorder

IX. Flow Chart (Attach separate paper if required)

X. 'C' Program Code(Attach separate paper if required)

XI. Resources required

Sr. No.	Name of Resource	Specification	Quantity	Remarks
1	Hardware: Computer System	Computer (i3-i5 preferable), RAM minimum 2 GB and onwards	As per batch size	For all Experiments
2	Operating system	Windows 7 or Later Version/LINUX version 5.0 or Later Version		
3	Software	Turbo C /C++ Version 3.0 or later,gcc compiler		

XII. Precautions

1. Handle dynamic memory allocation carefully.

XIII. Resources used

S. No.	Name of Resource	Specification
1	Computer System with broad specifications	
2	Software	
3	Any other resource used	

XIV Result (Output of the Program)

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XV Conclusion(s)

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XVI Practical Related Questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identified CO.

Choose right option from following:

1. Every binary tree with n elements have _ _ _ _no of edges.
   a) n **b)** n-1 **c)** n-2 **d)** n+1

2. Define inorder traversal **ans**: _ _ _ _
   a) left,root,right **b)** root,left,right **c)** left,right,root **d)** none

3. Define postorder traversal **ans**: _ _ _ _
   a) left,root,right **b)** root,left,right **c)** left,right,root **d)** none

4. Define converse postorder traversal **ans**: _ _ _ _
   a) left,root,right **b)** root,left,right **c)** right,left,root **d)** none

XVII Exercise

1. Create a binary search tree of capital alphabets.
2. Traverse the above Binary search tree recursively in Preorder

(Space for Answer)

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XVIII References / Suggestions for further Reading

1. https://www.tutorialspoint.com/data_structures_algorithms/binary_search_tree.htm
2. https://www.youtube.com/watch?v=r3xN36so6Jg
3. https://www.youtube.com/watch?v=sLDRH0HuZYM
4. https://www.youtube.com/watch?v=xoU69C4lKlM
5. https://www.youtube.com/watch?v=dDjQphXcISc
6. https://www.youtube.com/watch?v=eL8NZ-21lqI

XIX Assessment Scheme

Performance indicators		Weightage
Process related(10 Marks)		**30%**
1	Debugging ability	20%
2	Follow ethical practices.	10%
Product related (15 Marks)		**70%**
3	Correctness of algorithm	15%
4	Correctness of Program codes	25%
5	Quality of input/output messaging and output formatting	20%
6	Timely Submission of report	5%
7	Answer to sample questions	5%
Total (25 Marks)		**100%**

List of Students /Team Members

1. ……..
2. ……..
3. ……..
4. …….

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total(25)**	

List Of Laboratory Manuals Developed by MSBTE

First Semester:

1	Fundamentals of ICT	22001
2	English	22101
3	English Work Book	22101
4	Basic Science (Chemistry)	22102
5	Basic Science (Physics)	22102

Second Semester:

1	Bussiness Communication Using Computers	22009
2	Computer Peripherals & Hardware Maintenace	22013
3	Web Page Design with HTML	22014
4	Applied Science (Chemistry)	22202
5	Applied Science (Physics)	22202
6	Applied Machines	22203
7	Basic Surveying	22205
8	Applied Science (Chemistry)	22211
9	Applied Science (Physics)	22211
10	Fundamental of Electrical Engineering	22212
11	Elements of Electronics	22213
12	Elements of Electrical Engineering	22215
13	Basic Electronics	22216
14	'C' programming Language	22218
15	Basic Electronics	22225
16	Programming in "C"	22226
17	Fundamentals of Chemical Engineering	22231

Third Semester:

1	Applied Multimedia Techniques	22024
2	Advanced Serveying	22301
3	Highway Engineering	22302
4	Mechanics of Structures	22303
5	Building Construction	22304
6	Concrete Technology	22305
7	Strength Of Materials	22306
8	Automobile Engines	22308
9	Automobile Transmission System	22309
10	Mechanical Operations	22313
11	Technology Of Inorganic Chemicals	22314
12	Object Oriented Programming Using C++	22316
13	Data Structure Using 'C'	22317
14	Computer Graphics	22318
15	Database Management System	22319
16	Digital Techniques	22320
17	Principles Of Database	22321
18	Digital Techniques & Microprocessor	22323
19	Electrical Circuits	22324
20	Electrical & Electronic Measurment	22325
21	Fundamental Of Power Electronics	22326
22	Electrical Materials & Wiring Practice	22328
23	Applied Electronics	22329
24	Electrical Circuits & Networks	22330
25	Electronic Measurments & Instrumentation	22333
26	Principles Of Electronics Communication	22334
27	Thermal Engineering	22337
28	Engineering Matrology	22342
29	Mechanical Engineering Materials	22343
30	Theory Of Machines	22344

Fourth Semester:

1	Hydraulics	22401
2	Geo Technical Engineering	22404
3	Chemical Process Instrumentation & Control	22407
4	Fluid Flow Operation	22409
5	Technology Of Organic Chemicals	22410
6	Java Programming	22412
7	GUI Application Development Using VB.net	22034
8	Microprocessor	22415
9	Database Managment	22416
10	Electric Motors And Transformers	22418
11	Industrial Measurements	22420
12	Digital Electronics And Microcontroller Applications	22421
13	Linear Integrated Circuits	22423
14	Microcontroller & Applications	22426
15	Basic Power Electronics	22427
16	Digital Communication Systems	22428
17	Mechanical Engineering Measurments	22443
18	Fluid Mechanics and Machinery	22445
19	Fundamentals Of Mechatronics	22048

Fifth Semester:

1	Design of Steel and RCC Structures	22502
2	Public Health Engineering	22504
3	Heat Transfer Operation	22510
4	Environmental Technology	22511
5	Operating Systems	22516
6	Advanced Java Programming	22517
7	Software Testing	22518
8	Control Systems and PLC's	22531
9	Embedded Systems	22532
10	Mobile and Wireless Communication	22533
11	Industrial Machines	22523
12	Switchgear and Protection	22524
13	Energy Conservation and Audit	22525
14	Power Engineering and Refrigeration	22562
15	Solid Modeling and Additive Manufacturing	22053
16	Guidelines & Assessment Manual for Micro Projects & Industrial Training	22057

Sixth Semester:

1	Solid Modeling	17063
2	Highway Engineering	17602
3	Contracts & Accounts	17603
4	Design of R.C.C. Structures	17604
5	Industrial Fluid Power	17608
6	Design of Machine Elements	17610
7	Automotive Electrical and Electronic Systems	17617
8	Vehicle Systems Maintenance	17618
9	Software Testing	17624
10	Advanced Java Programming	17625
11	Mobile Computing	17632
12	System Programing	17634
13	Testing & Maintenance of Electrical Equipments	17637
14	Power Electronics	17638
15	Illumination Engineering	17639
16	Power System Operation & Control	17643
17	Environmental Technology	17646
18	Mass Transfer Operation	17648
19	Advanced Communication System	17656
20	Mobile Communication	17657
21	Embedded System	17658
22	Process Control System	17663
23	Industrial Automation	17664
24	Industrial Drives	17667
25	Video Engineering	17668
26	Optical Fiber & Mobile Communication	17669
27	Therapeutic Equipment	17671
28	Intensive Care Equipment	17672
29	Medical Imaging Equipment	17673

Pharmacy Lab Manual

First Year:

1	Pharmaceutics - I	0805
2	Pharmaceutical Chemistry - I	0806
3	Pharmacognosy	0807
4	Biochemistry and Clinical Pathology	0808
5	Human Anatomy and Physiology	0809

Second Year:

1	Pharmaceutics - II	0811
2	Pharmaceutical Chemistry - II	0812
3	Pharmacology & Toxicology	0813
4	Hospital and Clinical Pharmacy	0816

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