BUN
ISZ

7. Write an assembly language program to simulate the machine for following register reference instructions and determine the contents of AC, E, PC, AR and IR registers in decimal after the execution:
   CLA
   CMA
   CME
   HLT
8. Write an assembly language program to simulate the machine for following register reference instructions and determine the contents of AC, E, PC, AR and IR registers in decimal after the execution
   INC
   SPA
   SNA
   SZE

9. Write an assembly language program to simulate the machine for following register reference instructions and determine the contents of AC, E, PC, AR and IR registers in decimal after the execution:
   CIR
   CIL \
10. Write an assembly program that reads in integers and adds them together; until a negative non-zero number is read in. Then it outputs the sum (not including the last number).
11. Write an assembly program that reads in integers and adds them together; until zero is read in. Then it outputs the sum.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DSC07/DSC02/GE4a: DATA STRUCTURES

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

	Credits	Credit distribution of the course		

Course title & Code		Lecture	Tutorial	Practical /Practice	Eligibility criteria	Pre-requisite of the course (if any)
Data Structures	**4**	**3**	**0**	**1**	**Passed 12th class with Mathematics**	Programming using C++

Course Objectives

The course aims at developing the ability to use basic data structures like arrays, stacks, queues, lists, and trees to solve problems. C++ is chosen as the language to implement the implementation of these data structures.

Learning Outcomes

On successful completion of the course, students will be able to:

● Compare two functions for their rates of growth.

● Understand abstract specification of data-structures and their implementation.

● Compute time and space complexity of operations on a data-structure.

● Identify the appropriate data structure(s) for a given application and understand the trade-offs involved in terms of time and space complexity.

● Apply recursive techniques to solve problems.

Syllabus

Unit-1 **(9 hours)**

Growth of Functions, Recurrence Relations: Functions used in analysis, asymptotic notations, asymptotic analysis, recurrence, Master Theorem.

Unit-2 **(16 hours)**

Arrays, Linked Lists, Stacks, Queues: Arrays: array operations, applications, two dimensional arrays, dynamic allocation of arrays; Linked Lists: singly linked lists, doubly linked lists, circularly linked lists, Stacks: stack as an ADT, implementing stacks using arrays, implementing stacks using

linked lists, applications of stacks; Queues: queue as an ADT, implementing queues using arrays, implementing queues using linked lists,. Time complexity analysis.

Unit-3 **(5 hours)**

Recursion: Recursive functions, linear recursion, binary recursion.

Unit-4 **(6 hours)**

Trees, Binary Trees: Trees: definition and properties, tree traversal algorithms, and their time complexity analysis; binary trees: definition and properties, traversal of binary trees, and their time complexity analysis.

Unit-5 **(7 hours)**

Binary Search Trees: Binary Search Trees: insert, delete, search operations, time complexity analysis of these operations

Unit-6 **(2 hours)**

Binary Heap: Binary Heaps: heaps, heap operations.

Essential/recommended readings

1. Goodrich, M.T., Tamassia, R., & Mount, D., Data Structures and Algorithms Analysis in C++, 2nd edition, Wiley, 2011. 4 th
2. Cormen, T.H., Leiserson, C.E., Rivest, R. L., Stein C. Introduction to Algorithms, edition, Prentice Hall of India, 2022. Additional references

Additional References

1. Sahni, S. Data Structures, Algorithms and applications in C++, 2nd edition, Universities Press, 2011.
2. Langsam Y., Augenstein, M. J., & Tanenbaum, A. M. Data Structures Using C and C++, Pearson, 2009.

Practical List **(30 hours)**

1. Write a program to implement singly linked list as an ADT that supports the following operations:
   a. Insert an element x at the beginning of the singly linked list
   b. Insert an element x at ith position in the singly linked list
   c. Remove an element from the beginning of the singly linked list
   d. Remove an element from ith position in the singly link

e. Search for an element x in the singly linked list and return its pointer
f. Concatenate two singly linked lists

2. Write a program to implement doubly linked list as an ADT that supports the following operations:
   a. Insert an element x at the beginning of the doubly linked list
   b. Insert an element x at ith position in the doubly linked list
   c. Insert an element x at the end of the doubly linked list
   d. Remove an element from the beginning of the doubly linked list
   e. Remove an element from ith position in the doubly linked list.
   f. Remove an element from the end of the doubly linked list
   g. Search for an element x in the doubly linked list and return its pointer (viii) Concatenate two doubly linked lists
3. Write a program to implement circular linked list as an ADT which supports the following operations:
   a. Insert an element x at the front of the circularly linked list
   b. Insert an element x after an element y in the circularly linked list
   c. Insert an element x at the back of the circularly linked list
   d. Remove an element from the back of the circularly linked list
   e. Remove an element from the front of the circularly linked list
   f. Remove the element x from the circularly linked list
   g. Search for an element x in the circularly linked list and return its pointer
   h. Concatenate two circularly linked lists
4. Implement a stack as an ADT using Arrays.
5. Implement a stack as an ADT using the Linked List ADT.
6. Write a program to evaluate a prefix/postfix expression using stacks.
7. Implement Queue as an ADT using the circular Arrays.
8. Implement Queue as an ADT using the Circular Linked List ADT.
9. Write a program to implement Binary Search Tree as an ADT having the following operations:
   a. Insert an element x
   b. Delete an element x
   c. Search for an element x in the BST and change its value to y and then place the node with value y at its appropriate position in the BST
   d. Display the elements of the BST in preorder, inorder, and postorder traversal
   e. Display the elements of the BST in level-by-level traversal
   f. Display the height of the BST

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