Year : 2021-22
Semester : II

1. Name of Faculty : Dr. Rohit Tanwar
2. Course : Data Structures Lab
3. Program : B.Tech. CSE
4. Target : 50%

Course Code: CSEG1011P
L: 0
T: 0
P: 2
C: 1

COURSE PLAN

Target	50% (marks)
Level-1	40% (population)
Level-2	50% (population)
Level-3	60% (population)

1. Method of Evaluation

UG
Viva voce and Quiz (50%)
Performance & Records (50%)

2. Passing Criteria

Scale	UG
Out of 10 point scale	SGPA – "5.0" in each semester CGPA – "5.0" Min. Individual Course Grade – "C" Course Grade Point – "4.0"

*for UG, passing marks are 35/100 in a paper

3. Pedagogy

Solution to the problems should be designed (algorithm/flow-chart/pseudocode). After obtaining a successful design, the solution to the problem is implemented using C language. Students are evaluated based on Performance (via efficient design, implementation) and record-keeping, and preparation of students (via viva-voce and quiz).

4. References:

Text Books	Web resources	Reference books
1. Seymour Lipschutz, "Data Structures with C (Schaum's Outline Series)". 2. Yashavant P. Kanetkar, "Let us C".		1. E. Balagurusamy, "Programming in ANSI C". 2. Ellis Horowitz and SartazSahni, "Data Structure using C".

UPES
UNIVERSITY WITH A PURPOSE

Year : 2021-22
Semester : II

1. Name of Faculty : Dr. Rohit Tanwar
2. Course : Data Structures Lab
3. Program : B.Tech. CSE
4. Target : 50%

Course Code: CSEG1011P
L: 0
T: 0
P: 2
C: 1

GUIDELINES TO STUDY THE SUBJECT

Instructions to Students:

1. Go through the 'Syllabus' in the Black Board section of the web-site(https://learn.upes.ac.in) in order to find out the Reading List.
2. Get your schedule and try to pace your studies as close to the timeline as possible.
3. Get your on-line lecture notes (Content, videos) at Lecture Notes section. These are our lecture notes. Make sure you use them during this course.
4. Check your blackboard regularly
5. Go through study material
6. Check mails and announcements on blackboard
7. Keep updated with the posts, assignments and examinations which shall be conducted on the blackboard
8. Be regular, so that you do not suffer in any way
9. C**ell Phones and other Electronic Communication Devices:** Cell phones and other electronic communication devices (such as Blackberries/Laptops) are not permitted in classes during Tests or the Mid/Final Examination. Such devices MUST be turned off in the class room.
10. **E-Mail and online learning tool:** Each student in the class should have an e-mail id and a pass word to access the LMS system regularly. Regularly, important information – Date of conducting class tests, guest lectures, via online learning tool. The best way to arrange meetings with us or ask specific questions is by email and prior appointment. All the assignments preferably should be uploaded on online learning tool. Various research papers/reference material will be mailed/uploaded on online learning platform time to time.
11. **Attendance:** Students are required to have minimum attendance of 75% in each subject. Students with less than said percentage shall NOT be allowed to appear in the end semester examination.

This much should be enough to get you organized and on your way to having a great semester! If you need us for anything, send your feedback through e-mail to your concerned faculty. Please use an appropriate subject line to indicate your message details.

There will no doubt be many more activities in the coming weeks. So, to keep up to date with all the latest developments, please keep visiting this website regularly.

Year : 2021-22
Semester : II

1.	Name of Faculty	: Dr. Rohit Tanwar	Course Code: CSEG1011P
2.	Course	: Data Structures Lab	L: 0
3.	Program	: B.Tech. CSE	T: 0
4.	Target	: 50%	P: 2
			C: 1

RELATED OUTCOMES

1. The expected outcomes of the Program are:

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	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.
PO3	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.
PO4	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.
PO5	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.
PO6	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.
PO7	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.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team-work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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.
PO11	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.
PO12	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.

2. The expected outcomes of the Specific Program are:

UPES
UNIVERSITY WITH A PURPOSE

Year : 2021-22
Semester : II

1. Name of Faculty : Dr. Rohit Tanwar
2. Course : Data Structures Lab
3. Program : B.Tech. CSE
4. Target : 50%

Course Code: CSEG1011P
L: 0
T: 0
P: 2
C: 1

3. The expected outcomes of the Course are:

CO1	Implement elementary data structures like arrays, structures and linked list.
CO2	Implement Stack and queue with array and linked list.
CO3	Use searching and sorting algorithms and file handling.
CO4	Implement non-linear data structures to solve real-world problems

4. CO-PO/PSO Relationship Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**1**	**1**	**2**	**1**								**2**			
CO2	**1**	**1**	**2**	**1**								**2**			
CO3	**1**	**1**	**2**	**1**								**2**			
CO4	**1**	**1**	**2**	**1**								**2**			
Average	**1**	**1**	**2**	**1**								**2**			

1=weak 2= moderate 3=strong

5. Course Outcomes assessment plan:

Components Course Outcomes	File & Exp	Viva-1	Viva-2
CO1	✓	✓	
CO2	✓	✓	
CO3	✓		✓
CO4	✓		✓

UPES
UNIVERSITY WITH A PURPOSE

Year : 2021-22
Semester : II

1.	Name of Faculty	: Dr. Rohit Tanwar	Course Code: CSEG1011P
2.	Course	: Data Structures Lab	L: 0
3.	Program	: B.Tech. CSE	T: 0
4.	Target	: 50%	P: 2
			C: 1

List of Experiments

Exp No	Title
1	Array & Structure
2	Union and Dynamic Memory Allocation
3	Link List Data Structure and its Applications
4	Stack Data Structure
5	Queue Data Structures
6	Sorting algorithms
7	Searching algorithms
8	Hash Tables
9	Trees
10	Advanced Trees data structures
11	Graphs-I
12	Graphs-II

BROAD PLAN OF COURSE COVERAGE

Course Activities:

EXPERIMENT – 1

Title: 1- Array & Structure
Objective: To apply the concept of array, structure and experiment on nested array and array of structures.

List of Lab Activities:
Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

1. Find sum of all array elements using recursion.
2. Create an array ‘a1’ with ‘n’ elements. Insert an element in ith position of ‘a1’ and also delete an element from jth position of ‘a1’.
3. Convert uppercase string to lowercase using for loop.
4. Find the sum of rows and columns of matrix of given order (row x column).
5. Find the product of two matrices using pointers.
6. Store ‘n’ numbers (integers or real) in an array. Conduct a linear search for a given number and report success or failure in the form of a suitable message.

List of Practice Activities:

UPES
UNIVERSITY WITH A PURPOSE

Year : 2021-22
Semester : II

1. Name of Faculty : Dr. Rohit Tanwar — Course Code: CSEG1011P
2. Course : Data Structures Lab — L: 0
3. Program : B.Tech. CSE — T: 0
4. Target : 50% — P: 2

C: 1

Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

1. Find the Transpose and Inverse of a matrix.
2. Find if the given matrix of order (m x n) is a Sparse matrix or not. [Assume that a matrix can become a sparse matrix if more than half the total number of its elements have the value zero]
3. Store ‘n’ numbers (integers or real) in an array in ascending or descending order. Conduct a binary search for a given number and report success or failure in the form of a suitable message.
4. Find out the largest and smallest number in a given array.
5. Create an array ‘a1’ with ‘n’ elements.
   a. Copy all elements of ‘a1’ into another array ‘a2’ using pointers. Display the contents of both the arrays using pointers.
   b. Merge the contents of ‘a1’ and ‘a2’ into a new array ‘a3’.
6. Find the total number of alphabets, digits or special characters in a string.
7. Find whether the entered string is palindrome or not.
8. Count the number of words in a string.
9. Design a structure ‘product’ to store the details of the product purchased like product name, price per unit, number of quantities purchased, and amount spent. Get the name, price per unit, and number of quantities of the product purchased. Calculate the amount spent on the product and then display all the details of the procured product using structure pointers.
10. Design a structure ‘student_record’ to store student details like name, SAP ID, enrollment number, date of registration and data of birth. The element date of joining is defined using another structure ‘date’ to store date details like day, month, and year. Get data of ‘n’ students and then print the entered values [Hint: Use concept of Nested structures and Array of Structures].
11. Add two complex numbers by passing structure to a function as argument.

EXPERIMENT – 2

Title: Union and Dynamic Memory Allocation.

Objective: To implement the concept of union and experiment on dynamic memory allocation.

List of Lab Activities:

Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

1. Design a union ‘product’ to store the details of the product purchased like product name, price per unit, number of quantities purchased, and amount spent. Get the name, price per unit, and number of quantities of the product purchased. Calculate the amount spent on the product and then display all the details of the procured product.

2. Design a structure ‘subject’ to store the details of the subject like subject name and subject code. Using structure pointer allocate memory for the structure dynamically so as to obtain details of ‘n’ subjects using for loop.

EXPERIMENT – 3

Title: Link List Data Structure and its Applications
Objective: To experiment the concept of pointers, structure and dynamic memory allocation to realize linked list and its application.

List of Lab Activities:

Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

1. Implement single Linked List data structure and its operations like insert and delete in the beginning/end and nth position of the list, and display the items stored in the linked list.
2. Using single linked list and functions implement Stack and its operations like insert, delete, and display.

List of Practice Activities:

Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

1. Add two polynomials using Linked List.
2. Using single linked list, implement its basic operations like insert, delete, and display.
3. Implement Circular Linked List and its operations.
4. Implement Doubly Linked List and its operations.

EXPERIMENT – 4

Title: Stack Data Structure

Objective: To demonstrate use of arrays and linked list to implement Stack operations and applications of Stack.

List of Lab Activities:

Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

1. Using array and functions implement Stack and its operations like insert, delete, and display.
2. Reverse a string using stack.

List of Practice Activities:

Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

1. Using array and functions implement two Stacks and its operations (insert, delete, display).
2. Convert infix to postfix expression using stack and array.
3. Evaluate postfix expression using stack and array.

EXPERIMENT – 5

Title: Queue Data Structure

Objective: To demonstrate use of arrays and linked list to implement Queue operations and types of Queues.

List of Lab Activities:

Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

1. Using array and functions implement Queue data structure and its operations like insert, delete, and display.
2. Check whether the string is palindrome or not using array and Queue.

List of Practice Activities:

Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

1. Using array and functions implement Circular Queue data structure and its operations like insert, delete, and display.
2. Using array and functions implement Priority Queue and its operations (insert, delete, display).
3. Using array and functions implement Double Ended Queue (Input Restricted Deque and Output Restricted Deque) and its operations (insert, delete, display).
4. Using array and functions implement a Stack using Queues.

EXPERIMENT – 6

Title: Sorting algorithms

Year : 2021-22
Semester : II

1.	Name of Faculty	: Dr. Rohit Tanwar	Course Code: CSEG1011P
2.	Course	: Data Structures Lab	L: 0
3.	Program	: B.Tech. CSE	T: 0
4.	Target	: 50%	P: 2
			C: 1

Objective: To implement various sorting algorithms

List of Lab Activities

Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

1. Merge the contents of two lists to another.
2. Read the numbers from the user into an array and sort them using the insertion Sort algorithm.

List of Lab Activities

Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

1. Sort the given elements using the selection sort algorithm.
2. Implement quick sort for given array values.

EXPERIMENT – 7

Title: Searching algorithms
Objective: To implement linear search, binary search.

List of Lab Activities:

Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

1. WAP to implement linear and binary search algorithms

EXPERIMENT – 8

Title: Hash Tables
Objective: To implement hash tables with and without collision avoidance algorithms using arrays/linked lists.

List of Lab Activities
Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

List of Lab Activities:
Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

UPES
UNIVERSITY WITH A PURPOSE

Year : 2021-22
Semester : II

1.	Name of Faculty	: Dr. Rohit Tanwar	Course Code: CSEG1011P
2.	Course	: Data Structures Lab	L: 0
3.	Program	: B.Tech. CSE	T: 0
4.	Target	: 50%	P: 2
			C: 1

1. Implement a hash function on student SAP-ID and categorize them in to their 10 families based on the last three digits. Example: Student with SAP-ID 5000423 belongs to family 9 and student with SAP-ID 5000425 belongs to family 2 based on last three digits.
2. Implement a Hash table using arrays. Perform Insert, Delete and Search operations on the hash table using the above Hash function (S.No.1). Adopt a suitable user-defined exception handling strategy if collision occurs while inserting data.
3. Implement a Hash table using arrays. Perform Insert, Delete and Search operations on the hash table using the above Hash function (S.No.1) and with Linear probing as Collision avoidance strategy.

EXPERIMENT – 9

Title: Trees

Objective: To demonstrate the creation of a binary tree using arrays/linked lists and working with tree traversal and heap sorting algorithms.

List of Lab Activities

Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

List of Lab Activities:

1. Create a binary tree using an array/linked List.
2. Construct a Binary Tree and perform Inorder, Preorder and Postorder Traversal.
3. Implement Heap Sort.

EXPERIMENT – 10

Title: Graphs

Objective: To show the representation of graphs using adjacency matrix. And to implement graph traversing techniques

List of Lab Activities

Write algorithm and C program, compile, execute and test the code using Linux C compiler with suitable test cases.

1. Accept the vertices and edges for a graph and stores it as an adjacency matrix. Implement functions to print in-degree and out-degree of any vertex 'i'. Also display the adjacency matrix.
2. Accept the graph as an adjacency matrix and check if the graph is undirected. [Hint: The matrix for an undirected graph is symmetric.]

UPES
UNIVERSITY WITH A PURPOSE

Year : 2021-22
Semester : II

1. Name of Faculty : Dr. Rohit Tanwar
2. Course : Data Structures Lab
3. Program : B.Tech. CSE
4. Target : 50%

Course Code: CSEG1011P
L: 0
T: 0
P: 2
C: 1

Sessions: Total No. of Instructional periods available for the course