GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Subject Code: BE03000081
Subject Name: Data Structures

w. e. f. Academic Year:	2024-25
Semester:	3
Category of the Course:	Professional Core Course

Prerequisite:	Computer Programming & Utilization
Rationale:	Data structure is a subject of primary importance in Information and Communication Technology. Organizing or structuring data is important for implementation of efficient algorithms and program development. Efficient problem solving needs the application of appropriate data structure during program development. Understanding of data structures is essential for software development because they help organize and manipulate data efficiently. Choosing the right data structure can make your programs run faster and use less memory. The course will help students to develop the capability of selecting a particular data structure and apply it to solve problems effectively.

Course Outcomes:

Sr. No.	CO Statement	Marks % weightage
CO-1	Define and classify various data structures, storage structures and common operations on them.	10
CO-2	Use various linear data structures with their representation and perform different operations on them.	20
CO-3	Use various nonlinear data structures with their representation and perform different operations on them.	20
CO-4	Apply various searching and sorting techniques on small and large data set.	30
CO-5	Solve the given problem using an appropriate data structure to achieve optimal performance and compare its performance with Other possible data structures.	20

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	TW/SL	TH		ESE (E)	PA (M)	PA/ (I)	TW/ SL (I)	ESE (V)	
45	0	60	15	120	04	70	30	20	30	50	200

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	INTRODUCTION TO DATA STRUCTURES: Basic Terminology, Classification of Data Structure- Primitive and Non Primitive Data Structure, Linear and Non-Linear Data Structures, Examples of Primitive and Non Primitive Data Structures, storage representation of Primitive and Non Primitive Data Structures	04	10
2	LINEAR DATA STRUCTURE **Array:** Representation of arrays, Applications of arrays, sparse matrix and its representation **Stack:** Stack-Definitions & Concepts, Operations On Stacks, Applications of Stacks, Polish Expression, Reverse Polish Expression And Their Compilation, Recursion, Tower of Hanoi **Queue:** Representation Of Queue, Operations On Queue, Circular Queue, Priority Queue, Array representation of Priority Queue, Double Ended Queue, Applications of Queue **Linked List:** Singly Linked List, Doubly Linked list, Circular linked list, Linked implementation of Stack, Linked implementation of Queue, Applications of linked list.	13	30
3	NON LINEAR DATA STRUCTURE : **Trees:** Definitions and Concepts, Representation of binary tree, Binary tree traversal (Inorder, postorder, preorder), Threaded binary tree, Binary search trees, Conversion of General Trees To Binary Trees, Applications Of Trees **Graphs:** Graph-Matrix Representation Of Graphs, Elementary Graph operations,(Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree)	13	30
4	HASHING AND FILES TRUCTURES: Hashing: The symbol table, Hashing Functions, Collision- Resolution Techniques File Structure: Fixed and variable length record, File organizations: Sequential, Random Access, indexed and Relative/Random File Organization	07	15

5	Sorting & Searching: **Sorting:** Various sorting techniques: Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort **Searching:** Sequential Search and Binary Search	08	15
	TOTAL	**45**	**100**

Reference Books:

1. An Introduction to Data Structures with Applications. By Jean-Paul Tremblay & Paul G. Sorenson Publisher-Tata McGraw Hill.
2. Data Structures using C & C++ - By Tanenbaum Publisher – Prentice-Hall International.
3. Fundamentals of Computer Algorithms by Horowitz, Sahni, Galgotia Pub. 2001 ed.
4. Fundamentals of Data Structures in C++ - By Sartaj Sahani.
5. Data Structures: A Pseudo-code approach with C -By Gilberg & Forouzan Publisher-

   Thomson Learning.

List of Practical:

At least 10 practical should be performed by students using programming language.

1. Write a program to demonstrate the concepts of Call by Value and Call by reference.
2. Write a program to perform addition, subtraction, and multiplication of matrices using arrays.
3. Implement a stack using arrays and perform the following operations: Push, Pop, Peek, and Display.
4. Write a program to convert an infix expression to postfix using a stack.
5. Write a program to evaluate a postfix expression using a stack.
6. Implement the Tower of Hanoi problem using recursion.
7. Write a program to implement a queue using arrays and perform Enqueue, Dequeue, and Display operations.
8. Implement a circular queue using arrays and demonstrate its operations.
5. Write a menu driven program to implement following operations on the singly linked list.
   (a) Insert a node at the front of the linked list.
   (b) Insert a node at the end of the linked list.
   (c) Insert a node such that linked list is in ascending order. (according to info. field)
   (d) Delete the first node of the linked list.
   (e) Delete a node with a given value in info. field.
   (f) Delete a node after specified position.
6. Write a program to implement stack using linked list.
7. Write a program to implement queue using linked list.
8. Write a program to implement following operations on the circular linked list.
   (a) Insert a node at the end of the linked list.
   (b) Insert a node before specified position.

(c) Delete a first node of the linked list.
(d) Delete a node after specified position.

9. Write a program to implement following operations on the doubly linked list.
   (a) Insert a node at the front of the linked list.
   (b) Insert a node at the end of the linked list.
   (c) Delete a last node of the linked list.
   (d) Delete a node before specified position.
10. Implement recursive and non-recursive tree traversing methods for a binary tree – inorder, preorder and post-order traversal.
11. Write a program which create binary search tree. Also write a function to search an element from binary search tree.
12. Implement a graph using adjacency matrix and adjacency list representations.
13. Write a program to implement Bubble Sort.
14. Implement Quick Sort algorithm.
15. Write a program to implement Insertion Sort.
16. Write a program to implement binary search on a sorted array.
17. Write a program to create and display records using sequential file organization.

List of Open Source Software/learning website: Students must refer to following sites to enhance their learning ability.

1. NPTEL courses
2. Vlabs.iitb.ac.in
3. MOOCs - www.coursera.org, www.udacity.com, etc.

- **Activities suggested under self-learning:**

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1	Assignment writing. Numerical based assignment is preferable.	5 assignments of 3h each. Total = 15h	Based on the assignment submitted.
2	Problem solving/Coding using C, C++, Python, SCILAB, MATLAB, MS-EXCEL or any other relevant software	5 small coding-based problems of 3h each. Total = 15h	Based on the coding solution submitted.
3	Technical Video based learning related to the subject	Duration of video = 5h Report preparation & Presentation = 10h Total = 15h	Report /presentation based on the video learning outcomes.
4	Discussion on research paper based on relevant subject	3 research paper = 15h	Summarize research paper and evaluation critical parameters
5	Poster/chart/power point preparation on technical topics	Duration = 10 h	Based on poster/chart preparation and presentation skills
6	Application/Software development	Duration = 15 h	Depending on the complexity of the

			Application/Software
7	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
8	Seminar / Presentation	Duration for study and preparation=5h Report writing=3h Presentation=2h Total=10h	Topic can be selected technical content beyond syllabus
9	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 10h Total = 15h	Based on in-depth study, technical depth, data collected, fact finding, etc.
10	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
11	Self-learning on-line course	Minimum duration of the course should be 15h.	Examination based assessment at the end of course. Based on the certificate produced.
12	Complex problem solving	Maximum 3 problem. Study of the problem and solution finding, Total = 15h	Based on the depth of the solution submitted.
13	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
14	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
15	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment /health/any other issue	Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h	Based on evaluation of critical problems and solutions

Note:

- All the suggested activity should be related to the subject.
- Min 3 activities must be carried out as per the availability of faculties and students.
- The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.

- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

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