KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY
Deemed to be University
BHUBANESWAR-751024

School of Computer Engineering
Autumn Semester 2024

Course Plan

1. **Course code** : CS 21001
2. **Course Title** : Data Structures
3. **LTP Structure** :

L	T	P	Total	Credit
3	1	0	4	4

4. **Course Faculty** :
   Name : Dr. Arup Abhinna Acharya
   Email ID : aacharyafcs@kiit.ac.in
   Contact No. : 9861058079

5. **Base-lined date** : 10/07/2024
6. **Course offered to the School :** School Computer Engineering, School Electrical Engineering, School Electronics Engineering

7. **Course Objective:**

- To find the Time Complexity and Space Complexity of algorithms
- To understand various techniques of sorting and searching
- To design and implement operations on arrays, stacks, queues, and linked lists
- To understand the complex data structures such as tree and graph
- To solve real life problems

8. **Course Outcome:**

CO #	Detail
CO1	Understand the concept of data structure and the ability to choose appropriate data structures to represent data items in real world problems.
CO2	Ability to analyze the time and space complexities of Algorithms combinations. Implement data structure array, string representation and manipulations, pattern matching.
CO3	Implement data structures such as arrays, linked lists, stacks and queues and understand the concept of dynamic storage management, garbage collection and compaction.
CO4	Ability to design programs using a data structures such as trees, graphs.
CO5	Apply Algorithm for solving problems like sorting, searching, hashing and symbol table.
CO6	Effectively choose the data structure that efficiently models the information in a problem.

9. Course Contents

The course focuses on basic and essential topics in data structures and algorithms, including arrays, linked lists, Stacks, Queues, Trees, sorting algorithms, searching algorithms and graphs.

Sr#	Major Area	Detailed Area	CO
1	Introduction	Development of Algorithms, Notations and analysis, Storage structures for arrays, Sparse matrices, Stacks and Queues: Representations and applications.	CO1, CO2, CO3
2	Linked List, Stacks, and Queues	Linked Lists, Linked stacks and queues, Operations on polynomials, Doubly linked lists, Circularly linked lists, Dynamic storage management, Garbage collection and compaction.	CO2, CO3
3	Trees	Tree representation, Binary Trees, Binary search trees, Tree traversal, Expression manipulation, Symbol table construction, Height-balanced trees, AVL trees, B-Tree.	CO4, CO6
4	Graph	Graphs, Representation of graphs, BFS, DFS, Topological sort, String representation and manipulations, Pattern matching.	CO4, CO6
5	Sorting and Searching	Sorting Techniques: Selection, Bubble, Insertion, Merge, Heap, Quick, Radix sort, Linear search, Binary search, Hash table methods.	CO5, CO6

10. Text Book:

1. Sartaj Sahni, “Data Structures, Algorithms and Applications in C++”, Universities Press (I) Pvt. Ltd., 2008.

11. Reference Books:

1. J. P. Tremblay, P. G. Sorenson, “An Introduction to Data Structures with Applications”, Second Edition,Tata McGraw Hill, 1981.
2. M. Tenenbaum, Augestien, “Data Structures using C”, Third Edition, Pearson Education, 2007.
3. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Second Edition, Addison-WesleyEducational Publishers, 2006.

12. Reference Site:

RS1. NPTEL - https://onlinecourses.nptel.ac.in/explorer

RS2. Tutorials Point - https://www.tutorialspoint.com/data_structures_algorithms/RS3. Geeksforgeeks - http://www.geeksforgeeks.org/

14. Lesson Plan:

Lecture No.	Unit	Topics	Lesson #
1-4	Introduction	• Introduction • Course Coverage	1
		• Algorithm Specification • Algorithm Analysis	2
		• Time Complexity • Space Complexity • Class Work	3
5-10	Arrays	• Array Introduction • Row major order and address calculation	4
		• DMA – 1-D and 2-D arrays • Problem Solving • Pointers to array, Pointer to structure, Array of pointers	5
		• Array abstract data type (ADT) • Problem Solving	6
		• String representation and manipulations • Pattern matching	7
		• Polynomial & its Operation • Matrix Operations	8
		• Sparse Matrix and its Operation • Class Work	9-10
		• Tutorial Class	11
11-21	Linked List	• Introduction to Linked List • Advantages, Disadvantages, Applications • Representation	12
		• Class Work • Types of Linked List	13
		• Single Linked List Operation – Traversal, Insertion, Deletion, Insert Last, Delete Last Class Work	14-15
		• Double Linked List Operations • Class Work	16
		• Circular Linked List, Header Linked List: Operations • Class Work	17
		• Polynomial Representation • Polynomial Operations	18
		• Dynamic storage management • Garbage collection and compaction	19
		• Tutorial Class	20
22-31	Stacks & Queues	• Introduction to Stack • Stack Application • Stack Representation – Arrays	21
		• Stack Representation – Linked List • Stack ADT	22

		• Arithmetic Expression Evaluation • Class Work	23
		• Arithmetic Expression Conversion • Class Work	24
		• Introduction to Queues • Queues Application • Queues Representation – Arrays	25
		• Queues Representation – Linked List • Queues ADT • Class Work	26
		• Linear Queue Drawback • Circular Queues	27
		• Deques and its Operation	28
		Mid Semester Examination	
		• Priority Queue • Class Work	29
		• Tutorial Class	30
32-43	Trees	• Introduction to Trees • Trees Terminology • Class Work	31
		• Tress Application • Binary Tree – Full, Complete and Extended Binary Trees • Expression Trees • Class Work	32
		• Representation of Binary Tree – Linked and Array Representation • Binary Tree ADT	33
		• Arithmetic Expression Conversion • Class Work	34
		• Binary Tree Traversal Concept and Algorithm – In-Order, Pre- Order and Post-Order & Level- Order • Binary Tree Construction with different traversal	35
		• Class Work on Binary Tree • Threaded Binary Tree – Single and Double Threaded	36
		• Binary Search Tree • BST ADT – Search, insertion	37
		• BST ADT – Deletion, • Class Work	38
		• Balanced Binary Tree • AVL Tree • AVL Rotation Techniques, ADT	39
		• B-Tree	40

44-47	Graphs	• Introduction to Graph • Graph Terminology • Graph Application	41
		• Graph Representation • Class Work	42
		• Graph Operation – DFS and BFS, Topological sort • Class Work	43-44
		• Tutorial Class	45
48-51	Sorting	• Bubble Sort • Insertion Sort • Selection Sort	46
		• Quick Sort • Merge Sort	47
		• Heap Sort • Radix Sort	48
		• Tutorial Class	49
52-54	Searching, Hashing	• Linear Search • Binary Search	50
		• Hashing – Hash Function • Symbol table construction • Class Work	51-52
		• Hashing – Collision Resolution Technique • Tutorial Class	53

13. Assessment plan for active based teaching learning:

Considering the guidelines circulated and after discussing with the faculty members, following activity based teaching and learning is proposed to have the uniformity of subject delivery in all sections:

Assessment Components:

Sr #	Assessment Component	Time	Weightage/ Marks	Schedule
1	Mid-Semester Examination	1.5 Hrs	20	Refer Details in Student Handbook
2	Activity based Teaching and Learning	Throughout semester	30	Throughout semester
3	End-Semester Examination	2Hrs/ 3 Hrs	50	Refer Details in Student Handbook

Activity Calendar

Sl. No.	Activity Name & Course Outcome Mapping	Activity Type & Submission Mode	Marks	Tentative Schedule
1	Class Participation [CO-1, 2, 3, 4, 5 & 6]	Individual / During Class Hours	5	In-Class
2	Quiz/ Class Test –I [CO-1 & 4]	Individual / Online	5	1st Week of August'24
3	Quiz/ Class Test –II [CO-2, 3 & 4]	Individual / Online	5	1st Week of September'24
4	Quiz/ Class Test –III [CO-3 & 4]	Individual / Online	5	2nd Week of October '24
5	Assignment [CO-3 4, 5, 6]	Group (Mini Project) / Online	5	3rd Week of October'24
6	Quiz/ Class Test –IV [CO-3, 4, 5]	Individual / Online	5	1st Week of November '24
7	Quiz/ Class Test –V [Extra] [CO-1, 2, 3, 4, 5 & 6]	Individual / Online	5	3rd Week of November'24

Component wise distributions of the activities are listed below

Quiz (Problem Solving and Critical Thinking)	Interactive focus (Viva)	Assignments Problem Solving and Critical Thinking
Module wise or content wise several quizzes will happen (Each quiz will be of 5 marks)	Faculty Choice based Activity (during the class) (5 Mark)	**Assignment (Mini Project)** (15 Mark) **(**Based on Problem Solving and Critical Thinking)
Best two quiz marks will be considered out of three quiz marks		

14. **Attendance:** Every student is expected to be regular (in attendance) in all lecture classes, tutorials, labs, tests, quizzes, seminars etc and in fulfilling all tasks assigned to him / her. Attendance will be recorded and 75% attendance is compulsory.

15. **Makeup:**
    - No make-up examination will be scheduled for the mid semester examination. However, official permission to take a make-up examination will be given under exceptional circumstances such as admission in a hospital due to illness / injury, calamity in the family at the time of examination.
    - A student who misses a mid-semester examination because of extenuating circumstances such as admission in a hospital due to illness / injury, calamity in the family may apply in writing via an application form with supporting document(s) and medical certificate to the Director General of the School for a make-up examination.
    - Applications should be made within five working days after the missed examination.

16. **Discussion of Mid Semester performance:** Performance of the mid semester examination will be discussed in the class room

17. **Pre-end semester total marks:** To be announced and discussed in the class.
18. **Course Management System:** SAP Portal - is a software system designed to facilitate teachers in the management (instructional content, assessment and documentation) of the courses for their students, both teachers and students can monitor the system. Though usually considered as a tool and often used to complement the face-to-face classroom.

19. **Assignments (15 marks):**

20. **Critical thinking (5 marks): Mini-Project / Viva**

Critical thinking process is related to demonstrating the mini-project and is the group wise activity. The group has to submit the source code and 2 pages report capturing design aspect of the project like data structure used, algorithm used with space and time complexity and the input and output of the project.

21 Quiz (10 marks):

Two/Three quizzes with easy, moderate and difficulty level will be conducted at the mid and end of semester according to the standard of GATE. Sample quiz is shown for reference only. Faculties are free to give their own questions in the quiz. Evaluation is to be done by respective assigned subject teacher.

i. Consider a linear array int array[3][2] = {{45,23},{333,21},{90,45}} in 16-bit OS and the base address of the array is 1000 and is presented in memory as Row Major. What is the address of the element located at the index [1][1]____?

ii. Consider the tree arcs of a BFS traversal from a source node W in an unweighted, connected, undirected graph. The tree T formed by the tree arcs is a data structure for computing.

(A) the shortest path between every pair of vertices.

(B) the shortest path from W to every vertex in the graph.

(C) the shortest paths from W to only those nodes that are leaves of T.

(D) the longest path in the graph

Arup Abhinna Acharya
Course Coordinator