GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering
Level: Diploma
Branch: Information And Communication Technology
Course / Subject Code: DI03032031
Course / Subject Name: Data Structure and Applications

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

Prerequisite:	Computer Basics
Rationale:	Development of application systems and software that use underlying architecture of machines efficiently and effectively requires the ability to use and manipulate various types of Data Structures and other constructs. This being a fundamental ability which is language neutral yet requires use of a language for its implementation. This is a basic course which goes along with other programming courses to develop an integrated ability to efficient software development, hence this course is very important for computer engineers

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Comprehend the basic concepts of data structures, analysis terms, OOPs concepts, and recursive functions.	R, U
02	Apply basic operations on stack, queue and linked list data structures.	R, U, A
03	Apply basic operations on linked list data structure.	R, U, A
04	Apply different sorting and searching algorithms to the small data sets.	R, U, A
05	Illustrate algorithms to insert, delete and searching a node in tree.	R,U,A

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

Teaching and Examination Scheme:

Teaching Scheme (In Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	**T**	**PR**	**C**	ESE (E)	PA(M)	PA(I)	ESE (V)	
2	0	2	3	70	30	20	30	150

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Course Content:

S.No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Correctness of program & approach to implement logic	30
2	Readability and documentation of the program/Quality of input and output displayed (messaging and formatting)	10
3	Use python concepts to implement efficient program	20
4	Debugging ability	20
5	Program execution/answer to sample questions	20
Total		**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
30	**40**	**30**	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

UNDERPINNING THEORY:

The major underpinning theory is given below based on the higher level UOs of Revised Bloom's taxonomy that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

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Unit	Topics and Sub-topics	Teaching Hrs	% of Weightage

Unit – I
 	
Basic Concepts of Data Structures & OOP
	1.1 Data Structure Basic Concepts
	1.2 Types of data structures
	1.3 Analysis Terms (for the definitions purpose only) :
	     Time Complexity Space Complexity
	     Asymptotic Notations, Big 'O', Notation , Best case Time Complexity, Average case Time Complexity, Worst case Time Complexity
	1.4 OOPs Concepts
	1.5 Class and Object
	1.6 Constructors
	1.7 Types of methods: Instance method, Class method, static method
	1.8 Overview of Abstract data types
	1.9 Concept of Recursive functions
		4	6

Unit– II **Stack and Queues**	2.1 Overview of Stack 2.2 Operations on Stack - Push, Pop 2.3 Implementation of Stack using List 2.4 Application of Stack - Infix, Prefix and Postfix Forms of Expressions, Evaluations of postfix expression, Recursive Functions (Factorial, Fibonacci series) 2.5 Overview of Queue 2.6 Operations on Queue - Enqueue and Dequeue 2.7 Implementation of Queue using List 2.8 Limitation of Single Queue 2.9 Concepts of Circular Queue 2.10 Application of queue 2.11 Differentiate circular queue and simple queue	8	30

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Unit– III Linked List	3.1 Overview of Linked list 3.2 Types of Linked List 3.3 Basic operations on singly linked list: Insertion of a new node in the beginning of the list, at the end of the list, after a given node, before a given node, Deleting the first and last node from a linked list, Count the number of nodes in linked list. 3.4 Overview of circular linked list 3.5 Difference between circular linked list and singly linked list 3.6 Overview of doubly linked list 3.7 Applications of linked list	8	30
Unit– IV Searching and Sorting	4.1 Searching an element into List: Linear Search, Binary Search 4.2 Sorting Methods: Bubble Sort, Selection Sort, Quick Sort, Insertion Sort, Merge Sort	4	17
Unit– V Trees	5.1 Binary trees: Complete Binary Tree, Basic Terms: level number, degree, in-degree and out-degree, leaf node 5.2 Binary Search Tree: Insertion of a node in binary tree, Deletion of a node in binary tree, Searching a node in binary tree. 5.3 Tree Traversal: Inorder, Preorder, Postorder 5.4 Applications of Binary tree	6	17
	Total :	**30**	

References/Suggested Learning Resources:
   (a) Books:

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Data structures and algorithms in python	Goodrich	Wiley, 2013 ISBN: 978-1-118-29027-9
2	Introduction to Programming using Python	Y Daniel Liang	Pearson, 2012, ISBN 978-0132747189

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3	An Introduction to Data Structures with Applications	Jean-Paul Tremblay & Paul G. Sorenson	Tata McGraw Hill,2017, ISBN 978-0074624715
4	Python Data Structures and Algorithms	Benjamin Baka, David Julian	Packt Publishing, 2017, ISBN 978-1-78646-735-5
5	Data Structures and Algorithms using Python	Rance D. Necaise	Wiley, 2011, ISBN 978-0-470-61829-5
6	Python 3 Object oriented programming	Dusty Phillips	Packt Publishing, 2015, ISBN 978-1-78439-878-1

(b) Open-source software and website:

1. https://docs.python.org/3/tutorial/datastructures.html
2. http://interactivepython.org/runestone/static/pythonds/index.html
3. http://www.tutorialspoint.com/data_structures_algorithms
4. http://www.geeksforgeeks.org/data-structures/
5. http://www.studytonight.com/data-structures/
6. http://www.coursera.org/specializations/data-structures-algorithms
7. https://nptel.ac.in/courses/106106133 (Programming, Data structures and Algorithms, IIT Madras)
8. https://www.codecademy.com/learn/linear-data-structures
9. https://www.udacity.com/course/data-structures-and-algorithms-in-python--ud513
10. https://www.edx.org/learn/data-structures
11. https://www.sololearn.com/learning/1159

Suggested Course Practical List:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1.	Design an student class for reading and displaying the student information, the getInfo() and displayInfo() methods will be used respectively. Where getInfo() will be a private method.	I	02
2.	Design a class Complex for adding the two complex numbers and show the use of constructor.	I	02

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3.	Write Python class to represent a bank account. The class contains account holder name, account number, type of account and balance amount as the data members. The member functions are as follows: to initialize the data members, to deposit an amount, to withdraw an amount after checking balance, and to display name and balance.	I	02
4.	Write Python class to represent a Cricketer. The class contains name of cricketer, team name and run as the data members. The member functions are as follows: to initialize the data members, to set run and display run.	I	02
4.	Implement push and pop algorithms of stack using list.	II	02
5.	Implement a program to convert infix notation to postfix notation using stack.	II	02
6.	Implement a program to implement queue using list that performs following operations: enqueue, dequeue, display	II	02
7.	Implement various program to perform operation on singly linked list:	III	02
8.	Implement program to create and display circular linked list.	III	02
9.	Implement program to perform following operation on doubly linked list: traversal, searching, adding and removing node.	III	02
10.	Implement a python program to search a particular element from list using Linear and Binary Search.	IV	02
11.	Implement Bubble sort algorithm.	IV	02
12.	Implement Selection sort and Insertion sort algorithm.	IV	02
13.	Implement Merge sort algorithm.	IV	02
14.	Implement Quick sort algorithm.	IV	02
16.	Implement construction of binary search trees.	V	02
17.	Write a menu driven program to perform different operation on Binary Search Tree	V	04
	Total : Minimum 15 Practicals		**Min. 30 Hrs.**

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List of Laboratory/Learning Resources Required:

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Computer system with operating system: Windows 7 or higher Ver., macOS, and Linux, with 4GB or higher RAM, Python versions: 2.7.X, 3.6.X or higher	All
2	Python IDEs and Code Editors Open Source : IDLE, Jupyter, Spyder (Anaconda)	All

Suggested Project List:

A suggestive list of micro-projects is given here. This should relate highly with competency of the course and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Develop a Python Program that evaluate the given arithmetic expression using stack.
b) Develop a Python Program that maintain a queue of persons. In this queue user can add a person, delete a person and search a person.
c) Develop a Python Program that perform banking operations like withdraw cash, deposit cash and mini statement using appropriate data structure.
d) Develop a Python Program for process management algorithm by using appropriate data structure.
e) Develop a Python Program for print spooler using appropriate Data structure.
f) Develop a Python Program for Telephone Directory system. In this user can adding, searching, modifying, listing, and deleting records through the use of appropriate data structure.

g) **Phone directory application using doubly-linked lists-** This project can demonstrate the working of contact book applications and also teach you about data structures like arrays, linked lists, stacks, and queues. Typically, phone book management encompasses searching, sorting, and deleting operations. A distinctive feature of the search queries here is that the user sees suggestions from the contact list after entering each character.
h) **Hangman Game:** The Hangman program randomly selects a secret word from a list of secret words. A random word (E.g. a fruit name) is picked up from our collection and the player gets limited chances to win the game. When a letter in that word is guessed correctly, that letter position in the word is made visible. In this way, all letters of the word are to be guessed before all the chances are over.
i) **Stack and queue implementation using linked list:** Develop a python program

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that implements stack and queue operations using linked list representation.

Suggested Activities for Students:

Other than the classroom and laboratory learning, following are the suggested student-related *co- curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare small reports (of 1 to 5 pages for each activity). For micro project report should be as per suggested format, for other activities students and teachers together can decide the format of the report. Students should also collect/record physical evidences such as photographs/videos of the activities for their (student's) portfolio which will be useful for their placement interviews:

a) Provide students with code snippets and ask them to identify the Big O notation for each one.
b) Undertake micro-projects in teams.
c) https://code.org/, an hour of code may be organized and students are encouraged to participate
d) Students are encouraged to register themselves in various MOOCs such as: Swayam, edx, Coursera, Udemy etc. to further enhance their learning.
e) List the applications which are developed using Python data structures
f) Encourage students to participate in different coding competitions like hackathon, online competitions on code chef etc.
g) Encourage students to form a coding club at institute level and can help the slow learners.

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