Programme : Diploma in Information Technology (Sandwich Pattern)													
Course Code:					**Course Title : Data Structures**								
Compulsory / Optional: Compulsory													
Teaching Scheme and Credits							**Examination Scheme**						
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (3Hrs.)**	**FA-PR**	**SA**		**SLA**	**Total**
										PR	**OR**		
3	-	4	1	8	4	20	20	60	25	50#	-	25	200

Total IKS Hrs. for course:

Abbreviations: CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:
1. FA-TH represents an average of two class tests of 30 marks each conducted during the term.
2. SA-TH represents the end term examination.

I. Rationale

In today's information technology era, computer Technology plays an important role. Computer applications are all pervasive in day to day life of human being. It became compulsory to all employable to have sound knowledge of how computer works and process data and information. This subject covers from the basic concept of C to pointers in C. This course will act as "programming concept developer" for students. It will also act as "Backbone" for subjects like OOPS, VB, Windows Programming, JAVA, OOMD, etc.

II. Industry / Employer Expected Outcome

Students should be able to develop application in C programming.

III. Course Outcomes: Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1	Understand the different types data structures.
CO2	Implement different Searching and Sorting Techniques.
CO3	Use Stack and recursion concept.
CO4	Implement the Queue concept
CO5	Use Linked List ,Tree and Graph Concept, Block chain concepts.

Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned to CO's	Topics / Sub-topics
1	**TLO 1.1:** able to understand data structure, classification if DS **TLO 1.2**: understand array static data structure and addition and deletion of element in array. **TLO 1.3:** understand difference between static and dynamic data structure.	**Introduction to Data Structures:** 1.1Need of data structures. 1.2Definition of Data structure and Abstract data type. 1.3Classification of Data structures: Linear, non-linear, homogeneous, nonhomogeneous, static & dynamic. **Course Outcome- CO1 Teaching Hours – 06 Marks: 08 (R-02 U-04 A-02)**
2	**TLO 2.1:** understand concept of searching elements **TLO 2.2 :** Understand the sorting techniques using different algorithms.	**Searching and Sorting** 2.1 Searching Linear Search, Binary Search , Hash Search. 2.2 Sorting Bubble Sort Insertion Sort Selection Sort Merge Sort Quick Sort **Course Outcome- CO2 Teaching Hours – 08 Marks: 12 (R-02 U-04 A-06)**
3	**TLO 3.1:** Understand dynamic data structure Linked List features of Linked list **TLO 3.2:** Understand different types of linked list. **TLO 3.3**: Operations on linked list with program. **TLO 3.4:** understand concept of Blockchain.	**Linked List** 3.1 Introduction and Terminologies: Node, Next Address and Pointer, Null pointer, Empty list 3.2 Types of Linked List: Single Linked List, Doubly Linked List, Circular Linked List Doubly Circular Linked List 3.3 Operations on Single Linked List: Searching, Insertion - (At Front ,In between and At End), Deletion - (From Front ,In between, From End) 3.4 Blockchain data structure: Introduction to Blockchain, Applications of Blockchain **Course Outcome- CO2 Teaching Hours – 10 Marks:12(R-02 U-04 A-06)**

4	**TLO 4.1:** Understanding the working Stack DS and its implementation using ADT **TLO 4.**2: understand PUSH , POP, Overflow and Underflow operations on Stack. **TLO 4.**3: understand applications of Stack. **TLO 4.**4: Understand recursion concept with Stack.	**Stacks** 4.1 Definition & examples of Stack, Stack as an abstract data type implementations using arrays and dynamic memory allocation 4.2 Operations on Stack PUSH POP Top Of The Stack 4.3 Overflow & Underflow of Stack 4.4 Applications of Stack 4.5 Polish Notation 4.6 Reversing a List 4.7 Recursion **Course Outcome- CO3 Teaching Hours – 8 Marks:8 (R-02 U-04 A-02)**
5	**TLO 5.1:** Understand the working of Queue DS and its implementation using ADT **TLO 5.2**: understand different operations on Queue as enqueue & dequeue. **TLO 5.3**: Understand applications of Queue.	**Queue** 4.1 Definition & examples of Queue Queue as an abstract data type implementations using arrays and dynamic memory allocation 4.2 Operations on Queue 4.3 Types of Queue Priority Queue Circular queue 4.4 Application of Queue 4.5 Job Scheduling 4.6 Task Scheduling **Course Outcome- CO4 Teaching Hours – 08 Marks:08 (R-02 U-04 A-02)**
6	**TLO 6.1:** Understand Tree DS and its terminologies. **TLO 6.2** : Types of Tree with representation of Tree using array and linked list **TLO 6.3**: Different operations on Tree with different traversing algorithms. **TLO 6.4** : Understand Graph Ds with its Terminologies .	**Trees and Graphs** 5.1 Introduction and Terminologies: Sub-tree, root, leaf, left, non-leaf, right, parent, child, ancestor, descendant, brother, level, depth, height. 5.2 Types of Tree General Tree Binary Tree Binary Search Tree 5.3 Representation of Tree 5.4 Operations on Trees Insertion Deletion Searching - Depth-first search and Breadth-first search 5.5 Traversing - Pre-order, In-order ,Post-order 5.6 Introduction to GRAPHS Terminologies: Graph, node (Vertices), arcs (edge), directed graph, In-degree, Out-degree, adjacent, successor, predecessor, relation, weight, path, length **Course Outcome- CO5 Teaching Hours – 10 Marks:12 (R-02 U-04 A-06)**

IV. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

Sr No	Practical / Tutorial / Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant Cos
1	**LLO a:** able to understand array implementation. **LLO b:** able to implement addition and deletion operations on static data structure array.	Write a program for insertion and deletion of an element in an Array at given position.	4	CO1
2	**LLO a**: able to write program for linear and binary search. **LLO b**:able to differentiate between linear and binary search	Write a program to implement Linear and Binary Search Techniques	4	CO2
3	**LLO a**. able write program for different sorting algorithm. **LLO b**: clearly able to notice difference in terms of complexity of implementation.	Write a program to implement a) Quick sort b) Bubble sort c) Insertion d) Selection	4	CO2
4	**LLO a**: able to develop dynamic linked list. **LLO b**: develop different insertion, deletion operations on linked list	Write a program to implement following operations on Singly Linked List a)Create b)Insertion c)Deletion	4	CO5
5	**LLO a**: able to develop dynamic doubly linked list. **LLO b**: develop different insertion, deletion operations on linked list	Write a program to implement following operations on Doubly Linked List a)Create b)Insertion c)Deletion	4	CO5
6	**LLO**: able to understand stack DS implementation with different operation stack.	Write a program to implement the PUSH and POP operation of Stack	4	CO3
7	**LLO :** able to develop application of stack	Write a program to implement the do and undo activity using Stack	4	CO3
8	**LLO a**: able to develop program for expression conversion using stack.	Write a program to implement Infix Prefix and Postfix Operation	4	CO3
9	**LLO a:** able to develop Queue ds and perform enqueue and dequeue.	Write a program to implement different operations on Queue.	4	CO4
10	**LLO:** able to implement doubly linked list.	Write a program to implement the concept of Doubly ended Queue.	4	CO4
11	**LLO**: able to understand Queue application and implementation of it.	Write a program to implement Ticket Reservation of system which is based on following priorities	4	CO4

		VIP=5, Senior=4,Handicap=3, Ladies=2,General =1		
12	**LLO**:able to develop tree data structure using linked list & perform different operations on it	Write a program to insert and delete nodes in a Tree.	4	CO5
13	**LLO**: understand tree application and implement traversal to tree.	Write a program to implement Inorder Preorder and Postorder of Tree nodes	4	CO5
14	LLO: understand Graph and implement graph traversal .	Write a program to implement DFS and BFS	4	ALL
15	LLO: students will be able to create mini project using different dynamic data structures.	Mini Project		
		Total	60	

V. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):

1. Expression Conversion System (infix to postfix, postfix to infix etc.)
2. Railway Reservation system using appropriate DS
3. Tower Of Hanoi project
4. Binary Tree Projets

VI. Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction to Data Structures**	2	4		6
2	**Searching and Sorting**		4	4	8
3	**Linked List**	2	6	4	12
4	**Stack**	2	4	6	12
5	**Queue**	2	4	4	10
6	**Trees and Graphs**	4	4	4	12
	Total	**12**	**26**	**22**	**60**

VII. Assessment

Methodologies/Tools

Formative assessment (Assessment for Learning)

- Rubrics for continuous assessment based on process and product related performance indicators (25 marks)

Summative Assessment (Assessment of Learning)

- End term examination, Viva-voce, Workshop performance (50 marks)

VIII. COs - POs Matrix Form

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CO1	3	-	-		-	2	1	2		1
CO2	3	1	2	2	-	3	1		2	3
CO3	2	2	2	-	-	3	2	2	2	2
CO4	2	2	2	--	-	3	1	1	2	-
CO5	2	2	1	2	-	2	1	2	2	3
Legends: - High:03, Medium:02, Low:01, No Mapping: --										

IX. Suggested Learning Materials / Books

Sr. No	Author/ Publisher	Title	ISBN
1	Data Structure	Seymour Lipschutz , Tata McGraw Hill	10: 0070701989 13: 9780070701984
2	An Introduction to Data Structures with applications	Tremblay, Sorenson,Tata McGraw Hill	0070651507

X. Learning Websites & Portals

Sr.No	Link / Portal
1	https://www.geeksforgeeks.org
2	https://www.javatpoint.com/data-structure-tutorial
3	https://www.programiz.com/dsa/data-structure-types
4	https://www.tutorialspoint.com/data_structures
5	https://www.mygreatlearning.com/blog/data-structure-tutorial-for-beginners/
6	https://www.w3schools.in/data-structures

XI. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Ms.Dipali Gosavi	Lecturer In Information Technology Department	Government Polytechnic Mumbai
2	Mr.Pratap Bangosavi	Software Engineer	Lauren Information Technologies Pvt.Ltd
3	Ms. Pradnya Natekar	Lecturer in Computer engineering	Shree Baghubai Maftalal Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of _____ Engineering

Head of Department
Department of _____ Engineering

I/C, Curriculum Development Cell

Principal