GOVERNMENT POLYTECHNIC, AMRAVATI

(AN AUTONOMOUS INSTITUTE OF GOVT. OF MAHARASHTRA)

CURRICULUM DEVELOPMENT CELL

CURRICULUM 2023 (FIFTH REVISION)

PROGRAMME TITLE: DIPLOMA IN CM / IF ENGG

COURSE CODE: FC4503

COURSE TITLE: DATA STRUCTURE USING C

LEARNING SCHEME:

LEVEL OF COURSE	PRERE-QUISITE	Total IKS HRS	WEEKLY CONTACT HRS.			WEEKLY SL HRS.	TOTAL CREDITS	TOTAL WEEKS	TOTAL CONTACT HOURS		
			CL	TL	LL				CL	TL	LL
IV	FC2503	-	04	00	04	02	05	15	60	00	60

ASSESSMENT SCHEME:

PAPER DURATION (HRS)		THEORY-CL (Marks)				PRACTICAL-LL (Marks)		SELF LEARNING- SLA (Marks)	TOTAL (Marks)
TH-FA	TH-SA		TH -FA	TH-SA	TOTAL	PR-FA^	PR-SA		
1.30 Hrs	3 Hrs	MAX	30	70	100	25	50#	25	200
		MIN.	---	---	40	10	20	10	-

Abbreviations: CC—Common Course, FC – Fractional Course, ME – Mechanical Engineering (Programme Specific Course), IKS- Indian Knowledge System, CL – Classroom Learning, TL –Tutorial Learning, LL – Laboratory Learning, SL – Self Learning, FA – Formative Assessment, SA – Summative Assessment, TH – Theory, PR – Practical, SLA – Self Learning Assessment. **Legends:** @ - Internal Assessment, # - Internal & External Assessment, $ - Online MCQ Examination, * - FA-TH 30 Mark constitutes average of FA-TH1 and FA-TH2. ~~two parts one is 20 marks for Formative Assessment Test and other is 10 marks for Tutorial Learning Assessment.~~ ^ - Under practical FA, Continuous Assessment of Practical Work is to be done by Course Teacher as per CDC norms and rubrics.

Note: 1. Under the Theory FA, final marks are the Average of Two FA Tests to be conducted as per academic calendar of the term.

2. Question paper for TH-FA and TH-SA shall be set as per CDC norms and specification table.

Under the head SL Assessment, Assignment, Micro Activity, Presentation, Seminar, related to course is to be assessed by course teacher as per CDC norms and rubrics.

3. PR-SA to be conducted with practical based individual performance and related viva.

1. RATIONALE:

One of the most important courses in computer Engineering and Information Technology is data structures. Data structures provide efficient, organized, and scalable ways to store and manipulate data, thereby improving the performance and usability of software systems. Operations can be performed quickly with minimal resources with the use of proper Data structures. Data organization or structuring is essential for developing effective algorithms and programs. By understanding and leveraging different data structures appropriately, developers can build faster, more efficient, and

more reliable applications. Students will get the ability to develop logic and solve problem using principles of data structure.

2. COURSE OUTCOMES (COs):
At the end of this course, student will be able to: -
1. Perform basic operations on Arrays.
2. Apply Different Searching and Sorting techniques.
3. Implement basic operations on stack and queue using array representation.
4. Perform operations on Queue using Array.
5. Implement basic operations on Linked List
6. Implement techniques of Tree Traversal and Representation of Graph

3. DETAILED CONTENTS: THEORY-CL

Unit / CO No	Major Learning Unit Outcomes (in cognitive domain)	Topics and Sub-topics	Hrs	Marks
Unit I / CO1 **Introduction to Data Structures**	1.1 Classify the given type of Data Structures based on their characteristics and space. 1.2 1b. Explain complexity of the given algorithm in terms of time and space. 1.3 Perform operations on the given type of Data Structure.	1.1 Concept and need of DS, Abstract Data Type 1.2 Types of Data Structures: (i) Linear Data Structures (ii) Non-Linear Data Structures 1.3 Basics of Algorithm: Definition, Characteristics, Concept of Algorithm Complexity: (i)Time Complexity – Definition, Asymptotic Notations (ii)Space Complexity. 1.4 Operations on Data Structures: Traversing, Searching, Insertion, Deletion, Sorting	06	08
Unit II / CO2 **Searching and Sorting**	2.1 Develop algorithm to search the given key using different Searching Techniques. 2.2 Create algorithm to sort data using a given method.	2.1 Searching: Searching for an item in a data set using the following methods: (i) Linear Search (ii) Binary Search 2.2 Sorting: Sorting of data set in an order using the following methods: (i) Bubble Sort (ii) Selection Sort (iii) Insertion Sort (iv) Quick Sort (v) Radix Sort	10	12

Unit - III / CO3 Linked List	3.1 Differentiate between Static and Dynamic Memory Allocation. 3.2 Create a relevant structure using a Linked List to represent a Node. 3.3 Develop algorithms to add or remove a specified item from a Linear Linked List. 3.4 Develop algorithm to traverse a singly linked list.	3.1 Static and Dynamic Memory Allocation. 3.2 Introduction to Linked List, Terminologies: Node, Address, Pointer, Information field / Data field, Next pointer, Null Pointer, Empty List. 3.3 Type of Lists: Linear List, Circular List, Doubly Linked List. 3.4 Operations on a singly linked list: Traversing a linked list, Searching a key in linked list, Inserting a new node in a linked list (at the Beginning, at the End, at any given position) , Deleting a node from a linked list (at the Beginning, at the End, at any given position) 3.5 Applications of Linked List.	12	14
Unit - IV / CO4 Stack	4.1 Represent Stack using Array and Linked List. 4.2 Develop algorithms to carry out the PUSH and POP operations in a Stack. 4.3 Convert the given expression from Infix to Postfix using Stack. 4.4 Evaluate Postfix Expression.	4.1 Introduction to Stack: Definition, Stack as an ADT, Operations on Stack- PUSH, POP, Stack Operation Conditions – Stack Full / Stack Overflow, Stack Empty /Stack Underflow. 4.2 Stack Implementation using Array and Linked List. 4.3 Applications of Stack: Reversing a List, Polish Notations, Conversion of Infix to Postfix Expression, Evaluation of Postfix Expression, Recursion.	12	14
Unit - V / CO5 Queue	5.1 Represent Queue using Array and Linked List. 5.2 Compare characteristics of different types of Queue. 5.3 Create Algorithm to carry out the INSERT and DELETE Operations on a Queue.	5.1 Introduction to Queue: Definition, Queue as an ADT, Queue Operations: INSERT, DELETE, Queue Operation Conditions: Queue Full, Queue Empty. 5.2 Types of Queues: Linear Queue, Circular Queue, Concept of Priority Queue, Double-Ended Queue. 5.3 Linear Queue Implementation in memory using Array and Linked List. 5.4 Applications of Queue.	12	14

Unit - VI / CO6 Trees and Introduction to Graphs	6.1 Create Binary Search Tree for the given data set. 6.2 Develop algorithms to traverse the tree using the given method. 6.3 Represent the given Graph	6.1 Introduction to Trees, Terminologies: tree, degree of a node, degree of a tree, level of a node, leaf node, Depth / Height of a tree, In-degree & Out-Degree, Path, Ancestor & descendant nodes 6.2 Tree Types and Traversal methods Types of Trees: General tree, Binary tree, Binary search tree (BST). Binary tree traversal : In order traversal, Preorder traversal, Post order traversal 6.3 Introduction to Graph terminologies: graph, node (Vertices), arcs (edge), directed graph, undirected graph, in-degree, out-degree, adjacent, successor, predecessor, relation, path, sink, articulation point.	08	08

4. LIST OF PRACTICALS-LL

S. N	PRACTICAL LEARNING OUTCOMES (PLOs)	CO NO.
1.	* Write a 'C' program to perform following Operations on Array: Create, Insert, Delete, Display. (Use int/ char/ float/ short/ long/ double Array)	CO1
2.	Write a 'C' Program to Search a particular data from the given Array of numbers using: Linear Search Method.	CO2
3.	* Write a 'C' Program to Search a particular data from the given Array of Strings using Linear Search Method.	CO2
4.	* Write a 'C' program to Search a particular data from the given Array of numbers using Binary Search Method.	CO2
5.	Write a 'C' Program to Search a particular data from the given Array of Strings using Binary Search Method	CO2
6.	* Write a 'C' Program to Sort an Array of numbers using Bubble Sort Method.	CO2

7.	Write a 'C' Program to Sort an Array of Strings using Bubble Sort Method.	CO2
8.	* Write a 'C' Program to Sort an Array of numbers using Selection Sort Method.	CO2
9.	Write a 'C' Program to Sort an Array of numbers using Insertion Sort Method.	CO2
10.	* Write a 'C' Program to Implement Singly Linked List with Operations: (i) Insert at beginning, (ii) Search, (iii) Display	CO3
11.	* Write a C Program to Implement Singly Linked List with Operations: (i) Insert at end, (ii) Insert After, (iii) Delete (iv) Delete from given place (v) Delete at End (vi) Display	CO3
12.	Write a C Program to Implement Doubly Linked List with Operations: (i) Insert at end, (ii) Insert After, (iii) Delete (iv) Delete from given place (v) Delete at End (vi) Display	CO3
13.	*Write a C Program to Create Two Polynomials using a Linked List.	CO3
14.	Write a 'C' Program to add Two Polynomials using a Linked List.	CO3
15.	* Write a 'C' Program to perform PUSH and POP Operations on Stack using an Array.	CO4
16.	* Write a 'C' Program to perform PUSH and POP Operations on a Stack using a Linked List.	CO4
17.	* Write a 'C' program to perform multiplication of two numbers using recursion.	CO4
18.	Write a 'C' program to print given string in reverse using recursion.	CO4
19.	Write a 'C' program to create a Singly Linked List and traverse in reverse order using recursion.	CO4
20.	* Write a 'C' Program to perform INSERT and DELETE Operations on Linear Queue using an Array.	CO5
21.	* Write a 'C' Program to perform INSERT and DELETE operations on Linear Queue using a Linked List.	CO5
22.	*Write a 'C' Program to perform INSERT and DELETE operations on Circular Queue using an Array.	CO5
23.	Write a 'C' Program to perform INSERT and DELETE operations on Circular Queue using a Linked List.	CO5

24.	Write a 'C' Program to Create a Priority Queue using a Linked List.	CO5
25.	*Write C program to Implement BST (Binary Search Tree) and traverse the tree (Inorder, Preorder, Post order).	CO6
26.	Write C program to Implement BST (Binary Search Tree) and traverse the tree (Preorder, Post order).	CO6
27.	Write C program to calculate height of the given Binary Tree.	CO6
28.	*Write C program to find out largest nodes in a Binary Search Tree	CO6

(Practicals marked as * are compulsory)

Note :
   i. A suggestive list of *PLOs* is given in the above table. More such *PLOs* can be added to attain the COs and competency. A judicial mix of minimum *12* or more practical need to be performed, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.
   ii. The 'Process ' and 'Product ' related skills associated with each PLO is to be assessed according to CDC norms and rubrics.
   iii. The above *PLOs* also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory /field based experiences:
      a. Follow safety practices.
      b. Practice good housekeeping.
      c. Practice energy conservation.
      d. Handle equipments carefully.
      e. Plan for development of a program.
      f. Demonstrate working as a leader / a team member.
      g. Maintain hardware, tools and equipment.
      h. Follow ethical practices.

The ADOs are not specific to any one *PLOs*, but are embedded in many *PLOs*. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:
   ● 'Valuing Level' in 1st year
   ● 'Organizing Level' in 2nd year and
   ● 'Characterizing Level' in 3rd year

5. SUGGESTED STUDENT SELF LEARNING ACTIVITIES:
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 at least *01* group activity and *01* individual activities *(to be continued throughout the term).* For the following suggested activities prepare reports of about 5

pages for each activity, also collect/record physical evidences for student's portfolio which will be useful for their placement interviews:

   a. Students should prepare report on any micro activity related to course on different units as per the guidance of course teacher.
   b. Prepare assignments on different units as per the guidance of course teacher
   c. Prepare lab manual based on practical performed in laboratory.
   d. Give seminar on relevant topic.
   e. Library/E-Book survey regarding related course and prepare assignments on it for the course.
   f. Prepare power point presentation or animation for demonstrating emerging activities/technology in the course.
   g. Visit to institute/industry and prepare report.
   h. Develop learning materials, models, charts related to topic, course.
   i. Develop applications/ activities related to course which may be useful to society.
   j. Learning through various online platforms such as SWAYAM, Infosys Springboard, Spokentutorials etc. related to course.

6. SUGGESTED INSTRUCTIONAL STRATEGIES

These are sample strategies, which the teacher can use to accelerate (if required), the attainment of the various outcomes in this course:

   a. About *10-15% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for self-directed learning and assess the attainment of COs through classroom presentations.
   b. Use the proper equivalent analogy to explain different concepts.
   c. Use simulators/Animation/Online Videos/Field Visits/ Expert Lectures for the understanding of concept.

7. MAJOR EQUIPMENTS / INSTRUMENTS REQUIRED

Sr No.	Equipment Name with Broad Specification	Practical No.
1.	Computer System with all necessary Peripherals and Internet Connectivity. 'C' Compiler / GCC Compiler/ Online 'C' Compiler	ALL

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Marks per Unit	Distribution of Theory Marks		
			R Level	U Level	A Level
1	Introduction to Data Structures	08	2	6	--
2	Searching and Sorting	12	2	4	6
3	Linked List	14	4	6	4
4	Stack	14	4	4	6
5	Queue	14	4	6	4

6	Tree	08	2	2	4
Total		**70**	**18** (26%)	**28** (40%)	**24** (34%)

9. QUESTION PAPER PROFILE

Course Outcomes/ Q. No./ UNIT (Marks)	Sub-Question	Marks allotted with level (R,U,A)				TOTAL MARKS
		A	b	c	d	
CO1 / Q.1/UNIT 1 / (08)	(Any Two)	4(R)	4(U)	4(A)	--	08
CO2 / Q.2/UNIT 2 / (12)	**A**(Any Two)	2(R)	2(U)	2(U)	--	04
	B (Any Two)	4(U)	4(A)	4(A)	--	08
CO3 / Q.3/UNIT 3 / (14)	**A** (Any One)	2(R)	2(R)		--	02
	B(Any Three)	4(U)	4(U)	4(A)	4(A)	12
CO4 / Q.4/UNIT 4 / (12)	**A** (Any One)	2(R)	2(R)		--	02
	B(Any Three)	4(U)	4(U)	4(A)	4(A)	12
CO5 / Q.5/UNIT 5 / (12)	**A** (Any One)	2(R)	2(R)		--	02
	B(Any Three)	4(U)	4(U)	4(A)	4(A)	12
CO6 / Q.6/UNIT 6/ (12)	(Any Two)	4(R)	4(U)	4(A)	--	08
Total (70)						70(32) (Marks in bracket are Optional)

10. SUGGESTED LEARNING RESOURCES

SR.NO.	TITLE	AUTHOR	PUBLISHER
1.	Data Structures with 'C' (SIE) (Schaum's Outline Series)	Lipschutz	McGraw Hill Education, New Delhi ISBN: 978-0070701984
2.	Data Structures using 'C'	Balgurusamy, E.	McGraw Hill Education, New Delhi 2013, ISBN: 978-1259029547
3.	Data Structures using 'C'	ISRD Group	McGraw Hill Education, New Delhi 2013, ISBN: 978-12590006401
4.	Understanding Pointers in C	Yashwant Kanetkar	BPB ISBN 8170298911

11**. SOFTWARE/LEARNING WEBSITES.**

Sr.No.	Website	QR code	Content
1	https://www.javatpoint.com/data-structure-introduction		For All Content
2	https://www.geeksforgeeks.org/introduction-to-data-structure s/		For All Content
3	https://studytonight.com/data-structures/		For All Content
4	https://www.tutorialspoint.com/data_structures_algorithms/		For All Content
5	https://www.w3schools.in/data-structures/		For All Content

6	https://www.mygr eatlearning.com/bl og/data-structure-tutorial -for-beginners/		For All Content
7	https://byjus.com/ gate/introduction-to-data-structure-notes/		For All Content

12. CO-PO MAPPING

CO	PO1 Basic and Discipline knowledge	PO2 Problem analysis	PO3 Design and developme nt of solution	PO4 Engineeri g tools an experimer tal and testing	PO5 The Engineer practices for Society	PO6 Projec manag ment	PO7 Lifelo ng learni ng	PSO1 Logic developr ent and Impleme ntation	PSO2 Entrepren urship
1. Perform basic operations on Arrays.	2	-	-	1	-	-	1	3	--
2. Apply Different Searching and Sorting techniques.	2	2	2	1	1	-	1	3	2
3. Implement basic operations on stack and queue using array representation.	2	2	2	1	1	1	3	3	--
4. Perform operations on Queue using Array.	2	2	2	1	1	1	3	3	--
5. Implement basic operations on Linked List	2	2	2	1	1	1	3	3	--
6. Implement techniques of Tree Traversal and Representation of Graph	2	2	2	1	1	1	3	3	2

13. PERFORMANCE INDICATOR FOR LL

Sr. No	Performance indicator	Allocated Weightage in %
1	Use of correct syntax/tools/ equipment	20
2	Correctness of algorithm/ logic/ Operating Equipment Skillfully	20
3	Debugging ability/observations/methodology	10
4	Coding standards)/safety measures/standard practices	10
5	Quality of' input and output	10
6	Answer to sample questions	20
7	On time submission	10
	Total	100%

14. PERFORMANCE INDICATOR FOR TL

S. No.	Performance Indicators	Weightage in % (Group Activity)	Weightage in % (Individual Activity)
a.	Selection of topic and relevance	10	10
b.	Preparing and submission of execution plan	10	10
c.	Relevant Information collection	20	20
d.	Activity execution process	20	20
e.	Submission of self learning activity report	10	20
f.	Contribution of team members	10	-
g.	Evaluation of presentation & question answer	20	20
Total		100%	100%

15. PERFORMANCE INDICATOR FOR SL
Note: Refer Rubrics for evaluation of practicals provided by CDC.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE:

SR. NO.	NAME	DESIGNATION	INDUSTRY/INSTITUTE
1	Smt V.M.Aswar	Lecturer in Computer Engineering	Government Polytechnic Amravati

2	Smt.R.J.Rangari	Lecturer in Information Technology	Government Polytechnic Amravati
3	Mr.M.S.Rathod	Lecturer in Information Technology	Government Polytechnic Amravati
4	Smt.S.S.Chavhan	Lecturer in Computer Engineering	Government Polytechnic Amravati

Programme Board of Studies (Computer Engineering), Government Polytechnic, Amravati has approved the above course curriculum on 12/07/2024 and is adopted for Computer Engineering Programme.

CHAIRMAN
PROGRAMME BOARD OF STUDIES,
COMPUTER ENGINEERING
GOVERNMENT POLYTECHNIC,
AMRAVATI.

The Board of Studies has approved the above course curriculum on 15/07/2024.

The Governing Body has approved the above course curriculum on ---------