

Ref No:

SRI KRISHNA INSTITUTE OF TECHNOLOGY, BANGALORE



COURSE PLAN

Academic Year 2019-20

Program:	Information Science and Engineering
Semester :	3
Course Code:	17CSL38
Course Title:	DATA STRUCTURES LABORATORY
Credit / L-T-P:	2 / 0-1-2
Total Contact Hours:	40
Course Plan Author:	Y. Vamsi Krishna

Academic Evaluation and Monitoring Cell

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INSTRUCTIONS TO TEACHERS

- Classroom / Lab activity shall be started after taking attendance.
- Attendance shall only be signed in the classroom by students.
- Three hours attendance should be given to each Lab.
- Use only Blue or Black Pen to fill the attendance.
- Attendance shall be updated on-line & status discussed in DUGC.
- No attendance should be added to late comers.
- Modification of any attendance, over writings, etc is strictly prohibited.
- Updated register is to be brought to every academic review meeting as per the COE.

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Note : Remove “Table of Content” before including in CP Book

Each Laboratory Plan shall be printed and made into a book with cover page

Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

A. LABORATORY INFORMATION

1. Laboratory Overview

<i>Degree:</i>	BE	<i>Program:</i>	IS
<i>Year / Semester :</i>	2/III	<i>Academic Year:</i>	2019-20
<i>Course Title:</i>	DATA STRUCTURES LABORATORY	<i>Course Code:</i>	17CSL38
<i>Credit / L-T-P:</i>	2 / 0-1-2	<i>SEE Duration:</i>	180 Minutes
<i>Total Contact Hours:</i>	40	<i>SEE Marks:</i>	80 Marks
<i>CIA Marks:</i>	20	<i>Assignment</i>	---
<i>Lab. Plan Author:</i>	Vamsi Krishna Y	<i>Sign</i>	Dt : 03/08/19
<i>Checked By:</i>	Manjula K	<i>Sign</i>	Dt :

2. Laboratory Content

Expt.	Title of the Experiments	Lab Hours	Concept	Blooms Level
1	Design, Develop and Implement a menu driven Program in C for the following Array operations a. Creating an Array of N Integer Elements b. Display of Array Elements with Suitable Headings c. Inserting an Element (ELEM) at a given valid Position (POS) d. Deleting an Element at a given valid Position (POS) e. Exit. Support the program with functions for each of the above operations		Data Manipulation	L4 Analyze

2	Design, Develop and Implement a Program in C for the following operations on Strings a.Read a main String (STR), a Pattern String (PAT) and a Replace String (REP) b.Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR Support the program with functions for each of the above operations. Don't use Built-in functions.		Data Manipulation	L4
3	Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) a.Push an Element on to Stack b.Pop an Element from Stack c.Demonstrate how Stack can be used to check Palindrome d.Demonstrate Overflow and Underflow situations on Stack e.Display the status of Stack f.Exit Support the program with appropriate functions for each of the above operations		Stack Operations	L4
4	Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, %(Remainder), ^(Power) and alphanumeric operands.		Stack Operations	L4
5	Design, Develop and Implement a Program in C for the following Stack Applications a.Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ b.Solving Tower of Hanoi problem with n disks		Stack Operations	L4
6	Design, Develop and Implement a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) a.Insert an Element on to Circular QUEUE b.Delete an Element from Circular QUEUE c.Demonstrate Overflow and Underflow situations on Circular QUEUE d.Display the status of Circular QUEUE e.Exit Support the program with appropriate functions for each of the above operations		Queue Features	L4
7	Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, Branch, Sem, PhNo a.Create a SLL of N Students Data by using front insertion. b.Display the status of SLL and count the number of nodes in it c.Perform Insertion / Deletion at End of SLL d.Perform Insertion / Deletion at Front of SLL (Demonstration of stack) e.Exit		Linked List Characteristics	L4
8	Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data		Linked List Characteristics	L4

	with the fields: SSN, Name, Dept, Designation, Sal, PhNo a.Create a DLL of NEmployees Data by using end insertion. b.Display the status of DLL and count the number of nodes in it c.Perform Insertion and Deletion at End of DLL d.Perform Insertion and Deletion at Front of DLL e.Demonstrate how this DLLcan be used as Double Ended Queue f.Exit		cs	
9	Design, Develop and Implement a Program in C for the following operations on Singly Circular Linked List (SCLL) with header nodes a.Represent and Evaluate a Polynomial $P(x,y,z) = 6x^2y^2z - 4yz + 3x^3yz + 2xy^5z - 2xyz^3$ b.Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations.		Linked List Characteristics	L4
10	Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message e. Exit		Traversal Method	L4
11	Design, Develop and Implement a Program in C for the following operations on Graph(G) of Cities a.Create a Graph of N cities using Adjacency Matrix. b.Print all the nodes reachable from a given starting node in a digraph using DFS/BFS method		Traversal Method	L4
12	Given a File of N employee records with a set K of Keys(4- digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table(HT) of m memory locations with Las the set of memory addresses (2- digit) of locations in HT. Let the keys in K and addresses in L are Integers. Design and develop a Program in C that uses Hash function $H: K \rightarrow L$ as $H(K)=K \text{ mod } m$ (remainder method), and implement hashing technique to map a given key K to the address space L.Resolve the collision (if any) using linear probing.		File Organization	L4

3. Laboratory Material

Books & other material as recommended by university (A, B) and additional resources used by Laboratory teacher (C).

Expt.	Details	Expt. in book	Availability
A	Text books (Title, Authors, Edition, Publisher, Year.)	-	-
1	Fundamentals of Data Structures in C - Ellis Horowitz and Sartaj Sahni, 2nd edition, Universities Press,2014	In Lib	
2	Data Structures - Seymour Lipschutz, Schaum's Outlines, Revised 1st edition, McGraw Hill, 2014		
B	Reference books		
1	Data Structures: A Pseudo-code approach with C –Gilberg & Forouzan, 2nd edition, Cengage Learning,2014	In dept	
2	Data Structures using C, , Reema Thareja, 3rd edition Oxford press, 2012		

3	An Introduction to Data Structures with Applications- Jean-Paul Tremblay & Paul G. Sorenson, 2nd Edition, McGraw Hill, 2013		
4	Data Structures using C - A M Tenenbaum, PHI, 1989		
5	Data Structures and Program Design in C - Robert Kruse, 2nd edition, PHI, 1996		
C	Concept Videos or Simulation for Understanding		
C1	• https://www.geeksforgeeks.org/abstract-data-types/		
C2	• https://www.geeksforgeeks.org/data-structures/linked-list/		
C3	• https://www.geeksforgeeks.org/binary-tree-data-structure/		
C4			
C5			
D	Software Tools for Design	-	-
1	https://turbo-c.apponic.com/		
E	Recent Developments for Research	-	-
1			
2			
F	Others (Web, Video, Simulation, Notes etc.)	-	-
1	https://nptel.ac.in/courses/106102064/ (NPTEL course related to Data Structures course)		

4. Laboratory Prerequisites:

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

Students must have learnt the following Courses / Topics with described Content . . .

Expt.	Lab. Code	Lab. Name	Topic / Description	Sem	Remarks	Blooms Level
1	17pcd13/23	C Programing	1. Knowledge on Data Structures	2		L2
2	-	-	4. Knowledge of Architecture	-	Plan Gap Course	

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.

Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Expt.	Topic / Description	Area	Remarks	Blooms Level
1	Data structures and Algorithms	Programming		L3
3				
3				
5				

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B. Laboratory Instructions

1. General Instructions

SNo	Instructions	Remarks
1	Observation book and Lab record are compulsory.	
2	Students should report to the concerned lab as per the time table.	
3	After completion of the program, certification of the concerned staff in-charge in the observation book is necessary.	
4	Student should bring a notebook of 100 pages and should enter the readings /observations into the notebook while performing the experiment.	
5	The record of observations along with the detailed experimental procedure of the experiment in the Immediate last session should be submitted and certified staff member in-charge.	
6	Should attempt all problems / assignments given in the list session wise.	
7	It is responsibility to create a separate directory to store all the programs, so that nobody else can read or copy.	
8	When the experiment is completed, should disconnect the setup made by them, and should return all the components/instruments taken for the purpose.	
9	Any damage of the equipment or burn-out components will be viewed seriously either by putting penalty or by dismissing the total group of students from the lab for the semester/year	
10	Completed lab assignments should be submitted in the form of a Lab Record in which you have to write the algorithm, program code along with comments and output for various inputs given	

2. Laboratory Specific Instructions

SNo	Specific Instructions	Remarks
1	Start computer	
2	Open the text editor	
3	Select new file.	
4	Write the program	
5	Save the program with .c extension.	
6	Compile the program F9	
7	Execute the program F10	

C. OBE PARAMETERS

1. Laboratory Outcomes

Expt.	Lab Code #	COs / Experiment Outcome	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
-	-	At the end of the experiment, the student should be able	-	-	-	-	-

to . . .							
1	17CSL38.1	Choose the Data manipulation functions for array and strings using memory allocation methods	6	Data Manipulation	Demonstration	Labs	L5
2	17CSL38.2	Demonstration of stack operations on the expression using stacks	9	Stack Operations	Demonstration	Labs	L5
3	17CSL38.3	Determine the queue features on the problem using queue methods	3	Queue Features	Demonstration	Labs	L5
4	17CSL38.4	Compare linked list classification using linked list method	9	Linked List Characteristics	Demonstration	Labs	L5
5	17CSL38.5	Decide the hierarchical organization of data using binary search tree method	3	Hierarchical Organization	Demonstration	Labs	L5
6	17CSL38.6	Explain the traversal method on node and edges using graph operation	3	Traversal Method	Demonstration	Labs	L5
7	17CSL38.7	Importance of file organization on files and records using hash function.	3	File Organization	Demonstration	Labs	L5
-		Total	36	-	-	-	-

Note: Identify a max of 2 Concepts per unit. Write 1 CO per concept.

2. Laboratory Applications

Expt.	Application Area	CO	Level
1	Analyze the memory allocation method	CO1	L5
2	Code and debug the operations of stack	CO2	L5
3	Demonstrate the working of the data structure in queues	CO3	L5
4	Evaluate the operations of linked list	CO4	L5
5	Analyze hierarchical linear and non linear data-structures	CO5	L5
6	Implement the traversal methods	CO6	L5
7	Evaluate the searching & sorting method by organizing the file structures	CO7	L5

Note: Write 1 or 2 applications per CO.

3. Mapping And Justification

CO – PO Mapping with mapping Level along with justification for each CO-PO pair.

To attain competency required (as defined in POs) in a specified area and the knowledge & ability required to accomplish it.

Expt.	Mapping CO	Mapping PO	Mapping Level	Justification for each CO-PO pair	Level
-	CO	PO	-	'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'	-
1	CO1	PO1		The knowledge of structure and abstract data type can be applied to solve complex problems.	
2	CO2	PO2		These fundamental concepts of CS can be applied to solve complex problems	
2	CO2	PO3		Efficient algorithms can be designed based on their time complexity.	
3	CO3	PO2		These fundamental concepts of CS can be applied to solve complex problems	
4	CO4	PO4		Analysis of algorithms helps to select suitable algorithms and reach valid	

				conclusions.	
5	CO5	PO1		The knowledge of structure and abstract data type can be applied to solve complex problems.	
6	CO6	PO5		Complexity analysis can be applied in research and other innovative areas.	
7	CO7	PO3		The knowledge about the various data structures can be applied to solve complex engineering problems.	
8	CO8	PO4		This knowledge helps in suitable representations and thereby interpretation of data can be done efficiently	
9	CO9	PO2		These fundamental concepts of CS can be applied to solve complex problems	
10	CO10	PO5		Complexity analysis can be applied in research and other innovative areas.	
11	CO11	PO3		The knowledge about the various data structures can be applied to solve complex engineering problems.	
12	CO12	PO5		Complexity analysis can be applied in research and other innovative areas.	

4. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

Expt.	CO.#	Experiment Outcomes At the end of the experiment student should be able to . . .	Program Outcomes												Level				
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3	
1	17CSL38.1	Choose the Data manipulation functions for array and strings using memory allocation methods	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L5
2	17CSL38.2	Demonstration of stack operations on the expression using stacks	-	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	L5
3	17CSL38.3	Determine the queue features on the problem using queue methods	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	L5
4	17CSL38.4	Compare linked list classification using linked list method	1	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	L5
5	17CSL38.5	Decide the hierarchical organization of data using binary search tree method	1	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	L5
6	17CSL38.6	Explain the traversal method on node and edges using graph operation	-	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	L5
7	17CSL38.7	Importance of file organization on files and records using hash function.	-	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	L5
-	17CSL38	Average attainment (1, 2, or 3)	2	2	3	2													-
-	PO, PSO	1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design																	

5. Curricular Gap and Experiments

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Expt	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					
3					

Note: Write Gap topics from A.4 and add others also.

6. Experiments Beyond Syllabus

Topics & contents required (from A.5) not addressed, but help students for Placement, GATE, Higher Education, Entrepreneurship, etc.

Expt	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					
3					

D. COURSE ASSESSMENT

1. Laboratory Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Unit	Title	Teaching Hours	No. of question in Exam							CO	Levels
			CIA-1	CIA-2	CIA-3	Asg-1	Asg-2	Asg-3	SEE		
1	Arrays	03	1	-	1	-	-	-	1	CO1	L5
2	Strings	03	1	-	1	-	-	-	1	CO1	L5
3	Stack	03	1	-	1	-	-	-	1	CO2	L5
4	Conversion Of Expressions	03	1	-	1	-	-	-	1	CO2	L5
5a	Evaluation Of Expressions	02	1	-	1	-	-	-	1	CO2	L5
5b	Tower of Hanoi	01	1	-	1	-	-	-	1	CO2	L5
6	Queues	03	1	-	1	-	-	-	1	CO3	L5
7	Singly Linked List	03	-	1	1	-	-	-	1	CO4	L5
8	Doubly Linked List	03	-	1	1	-	-	-	1	CO4	L5
9	Circular Linked List	03	-	1	1	-	-	-	1	CO4	L5
10	Binary Search Tree	03	-	1	1	-	-	-	1	CO5	L5
11	Depth First Search	03	-	1	1	-	-	-	1	CO6	L5
12	Hash Functions	03	-	1	1	-	-	-	1	CO7	L5
-	Total	36	6	6	12	0	0	0	12	-	-

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Evaluation	Weightage in Marks	CO	Levels
CIA Exam – 1	08	CO1, CO2	L4
CIA Exam – 2	08	CO3, CO4	L4
CIA Exam – 3	08	CO5,CO6,CO7	L4
	-	-	-
Other Activities – define –	-	-	-

Slip test			
Final CIA Marks	20	-	-

SNo	Description	Marks
1	Observation and Weekly Laboratory Activities	04 Marks
2	Record Writing / Viva	08 Marks for each Expt
3	Internal Exam Assessment	08Marks
4	Internal Assessment	20 Marks
5	SEE	80Marks
-	Total	100 Marks

E. EXPERIMENTS

Experiment 01 : Arrays

-	Experiment No.:	1	Marks		Date Planned		Date Conducted	
1	Title	Arrays						
2	Course Outcomes	Choose the Data manipulation functions for array and strings using memory allocation methods						
3	Aim	Exercise on memory allocation						
4	Material / Equipment Required	Lab Manual						
5	Theory, Formula, Principle, Concept	Learn data structure classification for array with the memory allocation functions						
6	Procedure, Program, Activity, Algorithm, Pseudo Code	<ul style="list-style-type: none"> • step 1: start • step 2: write programming • step 3: save the program • step 4: compile • step 5:if error then correct the errors • step 6:run • step 7:stop 						
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	<ul style="list-style-type: none"> • - • - • - 						
8	Observation Table, Look-up Table, Output	<ul style="list-style-type: none"> • SAMPLE OUTPUT: • -----Menu----- • 1.Create • 2.Display • 3.Insert • 4.Delete • 5.Exit • Enter your choice: • 1 • Enter the size of the array elements: 5 • Enter the elements for the array: • 10 • 20 30 • 40 						

		<ul style="list-style-type: none"> • SAMPLE OUTPUT: -----Menu----- • 1.Create • 2.Display • 3.Insert • 4.Delete • 5.Exit • Enter your choice: 1 • Enter the size of the array elements: 5 • Enter the elements for the array: 10 20 30 40 50
9	Sample Calculations	<ul style="list-style-type: none"> • - Creating an array • - Displaying an array elements • - Inserting an element in to an array • - Deleting an array element
10	Graphs, Outputs	<ul style="list-style-type: none"> • Enter the elements for the array: 10 20 30 40 50
11	Results & Analysis	<ul style="list-style-type: none"> • - • -
12	Application Areas	<ul style="list-style-type: none"> • Analyze the memory allocation method
13	Remarks	
14	Faculty Signature with Date	



Experiment 02 : String

-	Experiment No.:	2	Marks		Date Planned		Date Conducted	
1	Title	String						
2	Course Outcomes	Choose the Data manipulation functions for array and strings using memory allocation methods						
3	Aim	Choose the String manipulation functions for array and strings using memory allocation methods						
4	Material Equipment Required	/Lab Manual						
5	Theory, Formula, Principle, Concept	Learn data structure organization for strings with the memory allocation functions						
6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: Start. Step 2: Read main string STR, pattern string PAT and replace string REP. Step 3: Search / find the pattern string PAT in the main string STR. Step 4: if PAT is found then replace all occurrences of PAT in main string STR with REP string. Step 5: if PAT is not found give a suitable error message. Step 6: Stop.						
7	Block, Circuit,							

	Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	Enter a main string This is Data Structure lab Enter a pattern string Data Structure Enter a replace string Data structure with C The resultant string is This is Data structure with C lab
9	Sample Calculations	Enter a text String enter pattern String Enter the replacing Sting
10	Graphs, Outputs	The resultant string is This is Data structure with C lab
11	Results & Analysis	
12	Application Areas	Analyze the memory allocation method
13	Remarks	
14	Faculty Signature with Date	


Experiment 03 : Stack

-	Experiment No.:	3	Marks		Date Planned		Date Conducted	
1	Title	Stack						
2	Course Outcomes	Demonstration of stack operations on the expression using stacks						
3	Aim	Implementation of stack operations						
4	Material Equipment Required	/Lab Manual						
5	Theory, Formula, Principle, Concept	Push Operations Pop Operations Display Operations						
6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: Start. Step 2: Initialize stack size MAX and top of stack -1. Step 3: Push integer element on to stack and display the contents of the stack. if stack is full give a message as 'Stack is Overflow'. Step 3: Pop element from stack along with display the stack contents. if stack is empty give a message as 'Stack is Underflow'. Step 4: Check whether the stack contents are Palindrome or not. Step 5: Stop.						

7	Block, Model, Reaction, Expected	Circuit, Diagram, Equation, Graph		
8	Observation Table, Look-up Table, Output	<pre> ----MAIN MENU---- 1. PUSH (Insert) in the Stack 2. POP (Delete) from the Stack 3. PALINDROME check using Stack 4. Exit (End the Execution) Enter Your Choice: 1 Enter an element to be pushed: 1 The stack contents are: ----- 1 </pre>		
9	Sample Calculations	Pushing the elements Popping the elements Checking the stack content form Palindrome Check overflow and underflow conditions		
10	Graphs, Outputs	<pre> ----MAIN MENU---- 1. PUSH (Insert) in the Stack 2. POP (Delete) from the Stack 3. PALINDROME check using Stack 4. Exit (End the Execution) Enter Your Choice: 1 Enter an element to be pushed: 1 The stack contents are: ----- 1 </pre>		
11	Results & Analysis			
12	Application Areas	Code and debug the operations of stack		
13	Remarks			
14	Faculty Signature with Date			

Experiment 04 : Conversion Of Expression

-	Experiment No.:	4	Marks		Date Planned		Date Conducted	
1	Title	Conversion Of Expression						
2	Course Outcomes	Demonstration of stack operations on the expression using stacks						
3	Aim	Exercise on Keywords and identifiers						
4	Material Equipment Required	/Lab Manual						
5	Theory, Formula, Principle, Concept	Identify infix ,postfix,prefix Expressions						

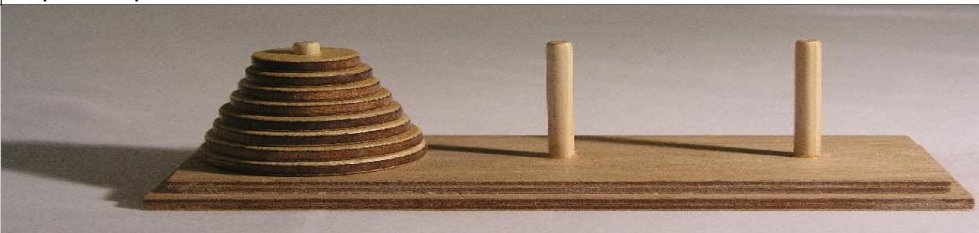
6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: Start. Step 2: Read an infix expression with parenthesis and without parenthesis. Step 3: convert the infix expression to postfix expression. Step 4: Stop
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	Enter a valid infix expression (a+(b-c)*d) The infix expression is: (a+(b-c)*d) The postfix expression is: abc-d*+
9	Sample Calculations	Precedence calculation comparing input character with the stack top character
10	Graphs, Outputs	Enter a valid infix expression (a+(b-c)*d) The infix expression is: (a+(b-c)*d) The postfix expression is: abc-d*+
11	Results & Analysis	
12	Application Areas	Code and debug the operations of stack
13	Remarks	
14	Faculty Signature with Date	

Experiment 05 a: Evaluation of expressions

-	Experiment No.:	5a	Marks		Date Planned		Date Conducted	
1	Title	Evaluation of expressions						
2	Course Outcomes	Demonstration of stack operations on the expression using stacks						
3	Aim	Evaluate the Suffix Expression using stack operations						
4	Material Equipment Required	/Lab Manual						
5	Theory, Formula, Principle, Concept	Evaluate the suffix Expression with single digit operands and operators +, -, *, /, %, ^						
6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: Start. Step 2: Read the postfix/suffix expression. Step 3: Evaluate the postfix expression based on the precedence of the operator. Step 4: Stop.						
7	Block, Circuit, Model Diagram,							

	Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	Enter the postfix expression: 23+ The result is: 5.000000
9	Sample Calculations	Computations of the operands with stack top elements with the operators
10	Graphs, Outputs	Enter the postfix expression: 23+ The result is: 5.000000
11	Results & Analysis	
12	Application Areas	Demonstrate the working of the data structure in queues
13	Remarks	
14	Faculty Signature with Date	

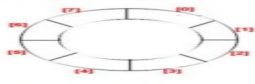




Experiment 05 b: Tower of Hanoi

-	Experiment No.:	5b	Marks		Date Planned		Date Conducted	
1	Title	Tower of Hanoi						
2	Course Outcomes	Demonstration of stack operations on the expression using stacks						
3	Aim	Moving the disk from first peg to third peg using auxiliary peg						
4	Material Equipment Required	/Lab Manual						
5	Theory, Formula, Principle, Concept	Perform the tower of hanoi using recursion method						
6	Procedure, Program, Algorithm, Pseudo Code	Step 1: Start. Step 2: Read N number of discs. Step 3: Move all the discs from source to destination by using temp rod. Step 4: Stop.						
7	Block, Model, Reaction Equation, Expected Graph							
8	Observation Table, Look-up Table, Output	Enter the number of discs: 3 Move disc 1 from A to C Move disc 2 from A to B Move disc 1 from C to B Move disc 3 from A to C Move disc 1 from B to A Move disc 2 from B to C Move disc 1 from A to C						

		Total Number of moves are: 7"
9	Sample Calculations	$2^n - 1$ where n I number of disk
10	Graphs, Outputs	Enter the number of discs: 3 Move disc 1 from A to C Move disc 2 from A to B Move disc 1 from C to B Move disc 3 from A to C Move disc 1 from B to A Move disc 2 from B to C Move disc 1 from A to C Total Number of moves are: 7"
11	Results & Analysis	
12	Application Areas	Demonstrate the working of the Tower of Hanoi
13	Remarks	
14	Faculty Signature with Date	

Experiment 06: Circular queues

-	Experiment No.:	6	Marks		Date Planned		Date Conducted	
1	Title	Circular queues						
2	Course Outcomes	Determine the queue features on the problem using queue methods						
3	Aim	Circular Queue Implementation						
4	Material Equipment Required	/Lab Manual						
5	Theory, Formula, Principle, Concept	Array Implementation of Queue with Maximum size						
6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: Start. Step 2: Initialize queue size to MAX. Step 3: Insert the elements into circular queue. If queue is full give a message as 'queue is overflow" Step 4: Delete an element from the circular queue. If queue is empty give a message as 'queue is underflow'. Step 5: Display the contents of the queue. Step 6: Stop.						

7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	<p>1) Initially: $front = 0$ and $rear = -1$</p>  <p>2) Add item 10 then $front = 0$ and $rear = 0$.</p>  <p>3) Now delete one item then $front = 1$ and $rear = 1$.</p>  <p>4) Like this now insert 30, 40, and 50, 50, 70, 80 respectively then $front = 1$ and $rear = 7$.</p>  <p>5) Now in case of linear queue, we can not access 0 block for insertion but in circular queue next item will be inserted of 0 block then $front = 0$ and $rear = 0$.</p> 
8	Observation Table, Look-up Table, Output	<p>1. Insert 2. Delete 3. Display 4. Exit Enter the choice: 1 Enter the character / item to be inserted: A 1. Insert 2. Delete 3. Display 4. Exit Enter the choice: 1</p>
9	Sample Calculations	<p>Insertion of elements Deletion of element</p>
10	Graphs, Outputs	<p>1. Insert 2. Delete 3. Display 4. Exit Enter the choice: 1 Enter the character / item to be inserted: A 1. Insert 2. Delete 3. Display 4. Exit Enter the choice: 1</p>
11	Results & Analysis	
12	Application Areas	Demonstrate the working of the data structure in queues
13	Remarks	
14	Faculty Signature with Date	

Experiment 07: Singly Linked List

-	Experiment No.:	7	Marks		Date Planned		Date Conducted	
1	Title	Singly Linked List						
2	Course Outcomes	Compare linked list classification using linked list method						
3	Aim	Singly linked list implementation						
4	Material Equipment Required	/Lab Manual						
5	Theory, Formula, Principle, Concept	Implement Menu driven with student data						
6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: Start. Step 2: Read the value of N. (N student's information) Step 2: Create a singly linked list. (SLL) Step 3: Display the status of SLL. Step 4: Count the number of nodes. Step 5: Perform insertion at front of list. Step 6: Perform deletion at the front of the list. Step 7: Perform insertion at end of the list. Step 8: Perform deletion at the end of the list.						

		Step 9: Demonstrate how singly linked list can be used as stack. Step 10: Demonstrate how singly linked list can be used as queue. Step 11: Stop.
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	1. Create 2. Display 3. Insert 4. Delete 5. Stack 6.Queue 7. Exit Enter your choice: 1 How many student data you want to create: 2 Enter USN, Name, Branch, Sem, Ph.No 1kt12cs001 kumar cs 3 9900099000 Enter USN, Name, Branch, Sem, Ph.No 1kt12is002 ravi is 3 9900099111
9	Sample Calculations	Create front insertion status informations deletion at end and front
10	Graphs, Outputs	1. Create 2. Display 3. Insert 4. Delete 5. Stack 6.Queue 7. Exit Enter your choice: 1 How many student data you want to create: 2 Enter USN, Name, Branch, Sem, Ph.No 1kt12cs001 kumar cs 3 9900099000 Enter USN, Name, Branch, Sem, Ph.No 1kt12is002 ravi is 3 9900099111
11	Results & Analysis	
12	Application Areas	Evaluate the operations of linked list
13	Remarks	
14	Faculty Signature with Date	

Experiment 08: Doubly Linked List

-	Experiment No.:	8	Marks	Date Planned	Date Conducted	
1	Title	Doubly Linked List				
2	Course Outcomes	Compare linked list classification using linked list method				
3	Aim	Implementation of Doubly linked list				
4	Material Equipment Required	/Lab Manual				
5	Theory, Formula, Principle, Concept	Menu driven Employee data storage				
6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: Start. Step 2: Read the value of N. (N student's information) Step 3: Create a doubly linked list. (DLL) Step 4: Display the status of DLL.				

		<p>Step 5: Count the number of nodes.</p> <p>Step 6: Perform insertion at front of list.</p> <p>Step 7: Perform deletion at the front of the list.</p> <p>Step 8: Perform insertion at end of the list.</p> <p>Step 9: Perform deletion at the end of the list.</p> <p>Step 10: Demonstrate how doubly linked list can be used as double ended queue.</p> <p>Step 11: Stop</p>
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	<p>1. Create 2. Display 3. Insert 4. Delete 5. Queue 7. Exit</p> <p>Enter your choice: 1</p> <p>How many employees data you want to create: 2</p> <p>Enter SSN, Name, Dept, Designation, Sal, Ph.No</p> <p>1 KUMAR CSE INSTRUCTOR 8000 900099000</p>
9	Sample Calculations	<p>Create</p> <p>front insertion</p> <p>status informations</p> <p>deletion at end and front</p>
10	Graphs, Outputs	<p>1. Create 2. Display 3. Insert 4. Delete 5. Queue 7. Exit</p> <p>Enter your choice: 1</p> <p>How many employees data you want to create: 2</p> <p>Enter SSN, Name, Dept, Designation, Sal, Ph.No</p> <p>1 KUMAR CSE INSTRUCTOR 8000 900099000</p>
11	Results & Analysis	
12	Application Areas	Evaluate the operations of linked list
13	Remarks	
14	Faculty Signature with Date	

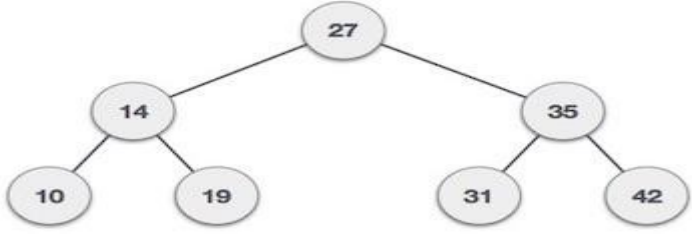
Experiment 09: Circular Linked List

-	Experiment No.:	9	Marks		Date Planned		Date Conducted	
1	Title	Circular Linked List						
2	Course Outcomes	Compare linked list classification using linked list method						
3	Aim	Evaluation of polynomial expressions using Circular linked list						
4	Material Equipment Required	/Lab Manual						
5	Theory, Formula, Principle, Concept	Represent and Evaluate polynomial expression						
6	Procedure, Program, Activity, Algorithm, Pseudo	<p>Step 1: Start.</p> <p>Step 2: Read a polynomial.</p> <p>Step 3: Represent the polynomial using singly circular linked list.</p>						

	Code	Step 3: Evaluate the given polynomial Step 4: Read two polynomials and find the sum of the polynomials. Step 5: Stop
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	<p>1) Write in Standard form $(3y^5 + y^4 + 2y^3 - 2y + 5) + (2y^5 + 3y^3 + 7y + 2)$</p> <p>2) Arrange in columns of like terms and then add</p> $\begin{array}{r} 3y^5 + y^4 + 2y^3 - 2y + 5 \\ 2y^5 + 3y^3 + 7y + 2 \\ \hline 5y^5 + y^4 + 5y^3 + 5y + 7 \end{array}$ <p>© mathwarehouse.com</p>
8	Observation Table, Look-up Table, Output	<p>1. Evaluate polynomial $P(x,y,z) = 6x^2y^2z - 4yz^5 + 3x^3yz + 2xy^5z - 2xyz^3$</p> <p>2. Add two polynomials</p> <p>3. Exit</p> <p>Enter your choice: 1</p> <p>Enter polynomial to evaluate:</p> <p>Enter coeff: 6</p> <p>Enter x, y, z powers (0-indicate NO term: 2 2 1)</p> <p>If you wish to continue press 1 otherwise 0: 1</p> <p>Enter coeff: -4</p>
9	Sample Calculations	$P(x,y,z) = 6x^2y^2z - 4yz^5 + 3x^3yz + 2xy^5z - 2xyz^3$
10	Graphs, Outputs	<p>1. Evaluate polynomial $P(x,y,z) = 6x^2y^2z - 4yz^5 + 3x^3yz + 2xy^5z - 2xyz^3$</p> <p>2. Add two polynomials</p> <p>3. Exit</p> <p>Enter your choice: 1</p> <p>Enter polynomial to evaluate:</p> <p>Enter coeff: 6</p> <p>Enter x, y, z powers (0-indicate NO term: 2 2 1)</p> <p>If you wish to continue press 1 otherwise 0: 1</p> <p>Enter coeff: -4</p>
11	Results & Analysis	
12	Application Areas	Evaluate the operations of linked list
13	Remarks	
14	Faculty Signature with Date	

Experiment 10: Binary Search Tree

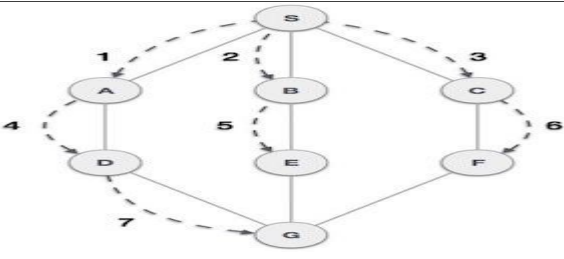
-	Experiment No.:	10	Marks		Date Planned		Date Conducted
1	Title	Binary Search Tree					
2	Course Outcomes	Decide the hierarchical organization of data using binary search tree method					
3	Aim	Implementing Tree operation using Binary Search tree					
4	Material Equipment Required	/Manual					
5	Theory, Formula, Principle, Concept	Travers the Binary tree in inorder, preorder and post order					
6	Procedure,	Step 1: Start.					

	<p>Program, Algorithm, Code</p> <p>Activity, Pseudo</p>	<p>Step 2: Create a Binary Search Tree for N elements. Step 3: Traverse the tree in inorder. Step 4: Traverse the tree in preorder Step 6: Traverse the tree in postorder. Step 7: Search the given key element in the BST. Step 8: Delete an element from BST. Step 9: Stop</p>
<p>7</p>	<p>Block, Model, Reaction, Expected Graph</p> <p>Circuit, Diagram, Equation,</p>	 <pre> graph TD 27((27)) --- 14((14)) 27 --- 35((35)) 14 --- 10((10)) 14 --- 19((19)) 35 --- 31((31)) 35 --- 42((42)) </pre>
<p>8</p>	<p>Observation Table, Look-up Table, Output</p>	<p>1. Insertion in Binary Search Tree 2. Delete Element in Binary Search Tree 3. Inorder 4. Preorder 5. Postorder 6. Exit Enter your choice: 1 Enter N value: 12 Enter the values to create BST like(6,9,5,2,8,15,24,14,7,8,5,2) 6 9 5 2 8 15 24 14 7 8 5 2 1. Insertion in Binary Search Tree 2. Delete Element in Binary Search Tree 3. Inorder 4. Preorder 5. Postorder 6. Exit Enter your choice: 3</p>
<p>9</p>	<p>Sample Calculations</p>	<p>$left_subtree (keys) \leq node (key) \leq right_subtree (keys)$</p>
<p>10</p>	<p>Graphs, Outputs</p>	<p>1. Insertion in Binary Search Tree 2. Delete Element in Binary Search Tree 3. Inorder 4. Preorder 5. Postorder 6. Exit</p>

		Enter your choice: 1 Enter N value: 12 Enter the values to create BST like(6,9,5,2,8,15,24,14,7,8,5,2) 6 9 5 2 8 15 24 14 7 8 5 2 1. Insertion in Binary Search Tree 2. Delete Element in Binary Search Tree 3. Inorder 4. Preorder 5. Postorder 6. Exit Enter your choice: 3
11	Results & Analysis	
12	Application Areas	Analyze hierarchical linear and non linear data-structures
13	Remarks	
14	Faculty Signature with Date	

Experiment 11: Breadth First Search

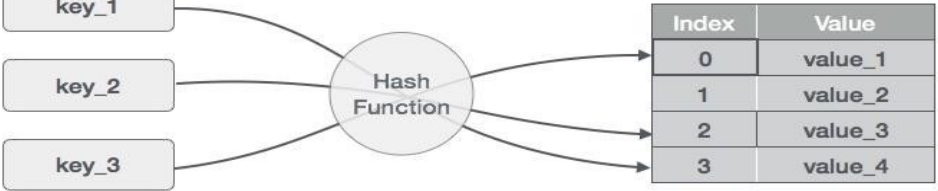
-	Experiment No.:	11	Marks		Date Planned		Date Conducted	
1	Title	Breadth First Search						
2	Course Outcomes	Explain the traversal method on node and edges using graph operation						
3	Aim	Traverse the graph using breadth first search methods						
4	Material Equipment Required	/Manual						
5	Theory, Formula, Principle, Concept	A graph $G = (V, E)$ where $v = \{0, 1, 2, \dots, n-1\}$ can be represented using two dimensional integer array of size $n \times n$						
6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: Start. Step 2: Input the value of N nodes of the graph Step 3: Create a graph of N nodes using adjacency matrix representation. Step 3: Print the nodes reachable from the starting node using BFS. Step 4: Check whether graph is connected or not using DFS. Step 5: Stop.						

7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	<p>1. Create Graph</p> <p>2.BFS</p> <p>Enter your choice: 1</p> <p>3.Exit</p> <p>Enter the number of vertices of the digraph: 4</p> <p>Enter the adjacency matrix of the graph:</p> <pre> 0 0 1 1 0 0 0 0 0 0 1 0 0 0 0 1 0 0 1 0 0 0 1 0 0 1 0 0 0 </pre> <p>1. Create Graph</p> <p>2.BFS</p> <p>Enter your choice: 2</p> <p>3.Exit</p> <p>Enter the source vertex to find other nodes reachable or not: 1</p> <p>3</p> <p>4</p> <p>2</p>
9	Sample Calculations	<p>Initially all vertices are unvisited. DFS starts in arbitrary vertex and runs as follows:</p> <ul style="list-style-type: none"> ⌚ Mark vertex u as visited. ⌚ For each edge (u, v), where u is unvisited , run depth-first search for u recursively. ⌚ Mark vertex u as DFS has finished processing the vertex. and backtrack to the parent.
10	Graphs, Outputs	<p>1. Create Graph</p> <p>2.BFS</p> <p>Enter your choice: 1</p> <p>3.Exit</p> <p>Enter the number of vertices of the digraph: 4</p> <p>Enter the adjacency matrix of the graph:</p> <pre> 0 </pre>

		0 1 1 0 0 0 0 0 1 0 0 0 1 0 0 1. Create Graph 2.BFS Enter your choice: 2 3.Exit Enter the source vertex to find other nodes reachable or not: 1 3 4 2
11	Results & Analysis	
12	Application Areas	Implement the traversal methods
13	Remarks	
14	Faculty Signature with Date	

Experiment 12: Hashing Functions

-	Experiment No.:	12	Marks		Date Planned		Date Conducted	
1	Title	Hashing Functions						
2	Course Outcomes	Importance of file organization on files and records using hash function.						
3	Aim	Organizing the employee records in a hash table by setting Keys						
4	Material Equipment Required	/Lab Manual						
5	Theory, Formula, Principle, Concept	Hash Table is a data structure which store data in associative manner. In hash table, data is stored in array format where each data values has its own unique index value.						
6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: Start. Step 2: Given a File of N employee records with a set K of Keys (4-digit) which uniquely determine the records in file F. Step 3: Assume that file F is maintained in memory by a Hash Table(HT) of m memory locations						

		<p>with L as the set of memory addresses (2-digit) of locations in HT. Step 3: Let the keys in K and addresses in L are Integers Step 4: Hash function H: $K \rightarrow L$ as $H(K)=K \text{ mod } m$ (remainder method) Step 5: Hashing as to map a given key K to the address space L, Resolve the collision (if any) is using linear probing. Step6: Stop .</p>
7	<p>Block, Circuit, Model Diagram, Reaction Equation, Expected Graph</p>	
8	<p>Observation Table, Look-up Table, Output</p>	<pre> Enter the data: 2 Enter emp id: 100 Enter emp name: Anand Do you wish to continue? (1/0): Enter the data: 4 Enter emp id: 101 Enter emp name: Kumar Do you wish to continue? (1/0): 1 0 1.Display ALL 2.Filtered Display Enter the choice: 1 The hash table is: HTKey EmpID 0 0 1 0 2 100 3 0 4 101 5 0 6 0 7 0 8 </pre>

		0 9 0 EmpName Anand Kumar
9	Sample Calculations	(1,20) (2,70) (42,80) (4,25) (12,44) (14,32) (17,11) (13,78) (37,98) S.n. Key Hash Array Index 1 1 1 % 20 = 1 1 2 2 2 % 20 = 2 2 3 42 42 % 20 = 2 2
10	Graphs, Outputs	Enter the data: 2 Enter emp id: 100 Enter emp name: Anand Do you wish to continue? (1/0): Enter the data: 4 Enter emp id: 101 Enter emp name: Kumar Do you wish to continue? (1/0): 1 0 1.Display ALL 2.Filtered Display Enter the choice: 1 The hash table is: HTKey EmpID 0 0 1 0 2 100 3 0 4 101 5 0 6 0 7 0 8 0 9 0 EmpName Anand

		Kumar
11	Results & Analysis	
12	Application Areas	Evaluate the searching & sorting method by organizing the file structures
13	Remarks	
14	Faculty Signature with Date	

F. Content to Experiment Outcomes

1. TLPA Parameters

Table 1: TLPA – Example Course

Expt-#	Course Content or Syllabus (Split module content into 2 parts which have similar concepts)	Content Teaching Hours	Blooms' Learning Levels for Content	Final Blooms' Level	Identified Action Verbs for Learning	Instruction Methods for Learning	Assessment Methods to Measure Learning
A	B	C	D	E	F	G	H
1	Write a C++ program to read series of names, one per line, from standard input and write these names spelled in reverse order to the standard output using I/O redirection and pipes. Repeat the exercise using an input file specified by the user instead of the standard input and using an output file specified by the user instead of the standard output.	3	L2 (Understand)	L2 (Understand)	Summarize	Demonstrate	Viva & presentation
2	Write a C++ program to read and write student objects with fixed length records and the fields delimited by " ". Implement pack (), unpack (), modify () and search () methods.	3	L3 (Apply)	L3 (Apply)	Develop	Demonstrate	Viva & presentation
3	Write a C++ program to read and write student objects with Variable - Length records using any suitable record structure. Implement pack (), unpack (), modify () and search () methods.	3	L3 (Apply)	L3 (Apply)	Develop	Demonstrate	Viva & presentation
4	Write a C++ program to write student objects with Variable - Length records using any suitable record structure and to read from this file a student record using RRN.	3	L4 Analyze	L4 Analyze	Develop	Demonstrate	Viva & presentation
5	Write a C++ program to implement simple index on primary key for a file of student objects. Implement add (), search (), delete () using the index.	3	L4 Analyze	L4 Analyze	Develop	Demonstrate	Viva & presentation
6	Write a C++ program to implement index on secondary key, the name, for a file of student objects. Implement add (), search (), delete () using the secondary index.	3	L3 Apply	L3 Apply	Develop	Demonstrate	Viva & presentation
7	Write a C++ program to read two lists of names and then match the names in the two	3	L3 Apply	L3 Apply	Develop	Demonstrate	Viva & presentation

	lists using Co Sequential Match based on a single loop. Output the names common to both the lists.						
8	Write a C++ program to read k Lists of names and merge them using k-way merge algorithm with k = 8.	3	L3 Apply	L3 Apply	Develop	Demonstrate	Viva & presentation
9	Mini Project	16	L6 (Create)	L6 (Create)	Design and create	Demonstrate	Viva & presentation

2. Concepts and Outcomes:

Table 2: Concept to Outcome – Example Course

Expt - #	Learning or Outcome from study of the Content or Syllabus	Identified Concepts from Content	Final Concept	Concept Justification (What all Learning Happened from the study of Content / Syllabus. A short word for learning or outcome)	CO Components (1.Action Verb, 2.Knowledge, 3.Condition / Methodology, 4.Benchmark)	Course Outcome Student Should be able to ...
A	I	J	K	L	M	N
1	File operations	File operations	File operations	Will be able to understand the basic file operations	Action Verb : Understanding Knowledge : File operations condition : C/ C++	Understanding the basic file operations using c/c++
2	Will know how to pack and unpack the contents with record and filed delimiter	Record Structure	Record Structure	Will be able to understand buffer management	Action Verb : Analyzing Knowledge : Record structure condition : C/ C++	Analyze fixed and variable length records in the file
3	Will demonstrate how to access in short time	Relative Record number	Relative Record number	Direct access	Action Verb : Evaluate Knowledge : Direct access condition : C/ C++	Compare the time taken in index based accessing by known index no
4	Will demonstrate single and multiple views on a file	Primary and secondary key	Primary and secondary key	Multiple views on a single table	Action Verb : Evaluate Knowledge : condition : C/ C++	Comparing single and multiple index based accessing of record
5	Will able to demonstrate parallel processing on files	Multiple file operations	Multiple file operations	Parallel processing	Action Verb : Analyzing Knowledge : Parallel Processing condition : C/ C++	Analyzing the operations on multiple files
6	Will be able design and	Operations on files	Operations on files with	Mini Project	Action Verb : Creating	Design and Develop the Project by menu

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	create a Mini Project	with menu based or graphical based	menu based or graphical based		Knowledge : Files and its operations on design	based or graphical
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