DATA STRUCTURES (KCS301)

Unit 1: (08 Lectures)

Introduction: Basic Terminology, Elementary Data Organization, Built in Data Types in C. Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic notations: Big Oh, Big Theta and Big Omega, Time-Space trade-off. Abstract Data Types (ADT)

Arrays: Definition, Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Derivation of Index Formulae for 1-D,2-D,3-D and n-D Array Application of arrays, Sparse Matrices and their representations.

Linked lists: Array Implementation and Pointer Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition Subtraction & Multiplications of Single variable & Two variables Polynomial.

Unit2: **(08 Lectures)**

Stacks: Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Iteration and Recursion- Principles of recursion, Tail recursion, Removal of recursion Problem solving using iteration and recursion with examples such as binary search, Fibonacci numbers, and Hanoi towers. Tradeoffs between iteration and recursion. Queues: Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues in C, Dequeue and Priority Queue.

Unit3: **(08 Lectures)**

Searching: Concept of Searching, Sequential search, Index Sequential Search, Binary Search. Concept of Hashing & Collision resolution Techniques used in Hashing. Sorting: Insertion Sort, Selection, Bubble Sort, Quick Sort, Merge Sort, Heap Sort and Radix Sort.

Unit4: **(08 Lectures)**

Graphs: Terminology used with Graph, Data Structure for Graph Representations: Adjacency Matrices, Adjacency List, Adjacency. Graph Traversal: Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm. Transitive Closure and Shortest Path algorithm: Warshal Algorithm and Dijikstra Algorithm.

Unit5: **(08 Lectures)**

Trees: Basic terminology used with Tree, Binary Trees, Binary Tree Representation: Array Representation and Pointer(Linked List) Representation, Binary Search Tree, Strictly Binary Tree ,Complete Binary Tree . A Extended Binary Trees, Tree Traversal algorithms: Inorder, Preorder and Postorder, Constructing Binary Tree from given Tree Traversal, Operation of Insertation , Deletion, Searching & Modification of data in Binary Search . Threaded Binary trees, Traversing Threaded Binary trees. Huffman coding using Binary Tree. Concept & Basic Operations for AVL Tree , B Tree & Binary Heaps.

COURSE PLAN

DATA STRUCTURES

KCS301

I. Course Description: Data structure is a subject of primary importance to the discipline of Computer Science. Organizing and structuring data is vital to the design and implementation of efficient algorithms and program development. This course is designed to help the students to gain an understanding of Data Structures Linear as well as non Linear.

II. PRE-Requisite: Student must have basic knowledge of computer operation, input, output devices some mathematical concepts such as basic mathematical formulas. Fibonacci series, Armstrong number, HCF, LCF, GCD of numbers and concept about matrix and an understanding of the 'C' programming language.

III. COURSE OUTCOME :

Course Outcome (CO)	**Bloom's Knowledge Level (KL)**	
At the end of course , the student will be able to understand		
CO 1	Ability to have the conceptual knowledge of different kind of data structure. Describe how arrays, linked lists, stacks, queues, trees, and graphs are represented in memory, used by the algorithms and their common applications.	**K1,K2**
CO 2	Able to write the Algorithms to solve a computational problem.	**K2**
CO3	Develop the program to create different data structure using C.	**K3**
CO4	Develop the programs for different operations on Array, Stack and Queue using C.	**K4**
CO5	Develop the program to perform different operation on Linked List, Graph, Tree etc.	**K5**
K1- Remember, K2- Understand, K3- Apply, K4- Analyze , K5- Evaluate , K6- Create		

IV. PROGRAM OUTCOMES (PO)

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3	**Design/Development of solutions:** Design solutions for complex engineering problems related to CSE and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural societal and environmental considerations

PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

V. PROGRAM SPECIFIC OUTCOME(PSO)

PSO1: Foundation of Mathematical Concepts: To use mathematical methodologies to crack problem using suitable mathematical analysis, data structure and suitable algorithm.

PSO2: Foundation of Computer System: the ability to interpret the fundamental concepts and methodology of computer systems. Students can understand the functionality of hardware and software aspects of computer systems.

PSO3: Foundations of Software Design and Development: the ability to grasp the software development lifecycle and methodologies of software systems. Possess competent skills and knowledge of software design process. Familiarity and practical proficiency with a broad area of programming concepts and provide new ideas and innovations towards research.

VI. MAPPING OF COURSE OUTCOME (CO'S), PROGRAMME OUTCOME (PO'S) AND PROGRAMME SEPECIFIC OUTCOME (PSO'S)

Course Outcome	PROGRAMME OUTCOME												PROGRAMME SPECIFIC OUTCOME		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			3									1	3		
CO2	2		2									2	3		
CO3			3									1	3		
CO4			3									2	3		
CO5			3									1	3		
Average	2		2.8									1.4	3		

Data Structures (KCS301): C203 **Year of Study 2020-21**

Course Outcome	PSO1	PSO2	PSO3
C 203.1	3		
C203.2	3		
C203.3	3		
C203.4	3		
C203.5	3		
Average	3		

VII. LECTURE PLAN:

UNIT	TOPICS	HR.	TEXT BOOK REFERRED	PAGE NO.
Unit 1	1. **Basic Terminology :** Data ,Data Item, Entity Set, Record , File, Key, Information	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**1.1**
	2. **Elementary Data organization :** Concept of Data Type, Definition Of Data structure, Primitive Data Type, Abstract Data Type	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**1.3-1.9, 2.20**
	3. **Description of various Data Structure:** Linear Arrays, Linked list, Stacks, Queues	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**1.3-1.9**

	4. **Description of various Data Structure:** Trees, Heaps, Graphs, One & two dimensional Arrays, Linked Lists	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**1.3-1.9**
	5. **Algorithm Complexity and Time Space Trade off:** Space Complexity, Time Complexity, Time, Space Trade Off.	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**2.14-2.17**
	6. **Asymptotic notations:** asymptotic notations, Big Oh Notation.	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**2.17**
	7. **Arrays**: Array Definition, Representation and analysis, Single and multidimensional Array	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**4.1-4.18**
	8. **Arrays**: Address Calculation, Operations on Arrays, Sparse Matrix	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**4.18-4.37**
	9. **Linked lists:** Representation & implementation of singly linked lists.	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**5.1-5.8**
	10. **Doubly Linked List:**	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**5.35**
	11. **Applications Of Linked Lists :** Addition of Polynomials, Multiplication of Polynomials, Representing Sparse Matrix.	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**5.31-5.51**
Unit 2	**1.Stack :** Primitive Stack operations, Push and pop	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**6.1**
	2. Implementation of stack: Static and dynamic implementation, Creation, insertion deletion.	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**6.2-6.7**
	3.Applications of stack : Infix, postfix representation of expression, Evaluation and conversion of various expression	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**6.9-6.14**
	4.Recursion : Principles of recursion, Types of recursion, removal of recursion ,tail recursion	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**6.18**
	5.Tower of Hanoi problem : simulation	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**6.22**
	6.Queues: Operations on queue, Insertion, deletion, checking empty and full queue	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**6.32**
	7.Types of queue Circular, linear, dequeue, priority queue	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**6.36**
	8. Static(Array) implementation of queue : Insertion, deletion, empty ,full check	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**6.39**

	9. **Dynamic (Linked) list implementation of queue** : Insertion, deletion, empty ,full check	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**6.40**
Unit 3	1. **Searching :** Concept of Searching	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**9.18**
	2.Searching: Sequential Search, Index searching	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**9.18**
	3. Searching : Binary Search	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**9.18**
	4.Hashing: Concept of Hashing	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**9.2**
	5.Hashing: Collision resolution Techniques used in Hashing	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**9.2**
	6. **Sorting** Insertion Sort, bubble sort	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**9.8**
	7. **Sorting techniques :** Selection Sort, Quick Sort	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**9.8-9.9**
	8. **Sorting techniques :**Merge sort	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**9.9-9.10**
	9. **Sorting techniques :** Heap Sort, radix sort	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**9.10-9.11**
Unit 4	**1. Graph terminology:** Various terms related to the graphs.	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**8.1**
	2.Graph representations : Sequential & Linked representation, Adjacency Matrix Representation Of the Graph, Adjacency List representation of the graph	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**8.5**
	3.Graph Traversal : Breadth First Search, Depth First Search, Strongly Connected Component	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**8.21**
	4.Application Of Graphs : Minimum cost spanning tree, Prim's & Kruskal Algorithm	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**8.7**
	5.Shortest Path Algorithms: Warshall's Algorithm, Dijkstra Algorithm	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**8.8**
Unit 5	**1.Tree:** Basic terminology, binary tree, root node, child node, degree of a node.	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**7.1 – 7.7**

	2.Binary tree: Binary tree Representation, Binary tree implementation.	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**7.12**
	3.Types of binary tree Rooted Trees, Ordered Trees, Position Trees, Complete Binary Trees, Extended Binary Trees	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**7.5-7.35**
	4. **Algebraic Expression** Prefix, infix, postfix Expression , representing the algebraic expression with the help of Tree	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**6.9**
	5. **Traversing Binary Trees** Pre Order Traversal Of a Binary Search Tree, In Order Traversal Of a Binary Search Tree, Post Order Traversal of a Binary Search Tree	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**7.9**
	6.Operations on Binary Search Tree Determining Height of a Binary Search Tree, Determining Number of Nodes/Elements, Determining Number of Internal Nodes, Inserting a new element, Searching an element	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**7.24**
	7. **Threaded Binary Trees** Representing a Threaded Binary Tree in Memory, Traversing threaded Binary tree	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**7.46**
	8. **Tree Applications :** Huffman Coding	**1**	Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH	**67**
TOTAL LECTURES =40 HOURS				

Text Book(s):

1. Seymour Lipschutz, Data Structures, Schaum's Outline Series, TMH
2. Reema Thareja, Data Structures Using C,Oxford University Press
3. Yashwant Kanetkar, Data Structures through C, BPB Publications

Reference Book(s):

1. G A V Pai, "Data Structures and Algorithms", TMH
2. Horowitz and Sahani, "Fundamentals of Data Structures", Galgotia Publication
3. AK Sharma, "Data Structure Using C", Pearson Education India.
4. Jean Paul Trembley and Paul G. Sorenson, "An Introduction to Data Structures with applications", McGraw Hill.
5. R. Kruse etal, "Data Structures and Program Design in C", Pearson Education.
6. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein, "Data Structures Using C and C++", PHI Learning Private Limited, Delhi India
7. P. S. Deshpandey, "C and Data structure", Wiley Dreamtech Publication

TUTORIAL SHEETS
DATA STRUCTURES
KCS301

NOTE: Every Student must submit each Tutorial Sheet within Three Days of completion of The Unit Related to the Sheet for its Evaluation. Each tutorial sheet is of 10 marks.

TUTORIAL SHEET 1

1. Explain the terms data, record, file and information?
2. Discuss about a Data Type? Explain its different categories**.(UPTU 2011-12)**
3. Discuss about algorithm complexity? Discuss about the need of measuring the complexity of an algorithm? **(UPTU 2012-13)**
4. Which of the following data structure is linear type? (**Gate 2004)**
Option A: Strings
Option B: Lists
Option C: Queues
Option D :All of the above

5.The time complexity of an efficient algorithm to find the longest monotonically increasing subsequence of n numbers is (**Gate)**
Option A: O(n)
Option B: O(n Ig n)
Option C: O(n*n)
Option D: None of the above

TUTORIAL SHEET 2

1. Discuss about an array? What are different types of arrays? **(UPTU 2012-13)**
2. How a linear array is represented in memory? Give example. **(UPTU 2013-14)**
3. How a two dimensional array is represented in memory? Give example.
4. Let T(n) be the function defined by T(n) = 1 and T(n) = 2T (n/2) + n, which of the following is TRUE ?
Option A: T(n) = O(n*n*n), Option B: T(n) = O(log2n) **Option C: T(n) = O(n)** , Option D: T(n) = O(n*n)
(Gate)
5.The efficient data structure to insert/delete a number in a stored set of numbers is **(Gate)**
Option A: Queue
Option B: Linked List
Option C: Doubly Linked List
Option D:Binary Tree

TUTORIAL SHEET 3

1.Given the following arithmetic expression in infix notation as 12/(7-3)+2*(3+8)-7 Translate this expression into postfix notation and then evaluate it using tabular method**..(AKTU 2015-16)**
2. What do you mean by recursion? Implement Tower of Hanoi with four disks.Draw tree Diagram with stack contents**.(UPTU 2014-15)**
3. How peek() operation differs from pop() operation. Explain with Example.
Gate Questions:
4.Given an empty stack, after performing push (1), push (2), Pop, push (3), push (4), Pop, Pop, push(5), Pop, what is the value of the top of the stack ? **(Gate)**
Option A: 4, Option B: 3 Option C: 2 , Option D: 1

5. Which of the following permutations can be obtained in the output using a stack of size 3 elements assuming that input, sequence is 1, 2, 3, 4, 5 ? **(Gate)**

Option A: 3, 2, 1, 5, 4, **Option B: 5, 4, 3, 2, 1** Option C: 3, 4, 5, 2, 1 , Option D: 3, 4, 5, 1, 2

TUTORIAL SHEET 4

1. Discuss about a queue? Is queue a linear or non linear data structure? Explain with Example. **(UPTU2014-15)**
2. How can we implement a queue in C with Insert and delete operations? Explain with Example. Show dry run**.(UPTU 2010-11)**
3. Explain the term Dequeue in detail.
4. Explain the term Priority Queue in detail. **(Gate)**

Consider the following statements for priority queue : S1 : It is a data structure in which the intrinsic ordering of the elements does determine the result of its basic operations. S2 : The elements of a priority queue may be complex structures that are ordered on one or several fields. Which of the following is correct?

Option A: Both S1 and S2 are incorrect., Option B: S1 is correct and S2 is incorrect.
Option C: S1 is incorrect and S2 is correct Option D: Both S1 and S2 are correct

5. . Give the name of the Linear list in which elements can be added at ends but not in the middle: **(Gate)**

Option A: Array., **Option B: Queue.,** Option C: Tree , Option D: Circular Queue

TUTORIAL SHEET 5

1. WAP to create a linked list, with all conditions. Explain how nodes can be created dynamically in a linked list**.(AKTU 2015-16)**
2. WAP for the Polynomial addition and explain with example.
3. How can a node be inserted in the beginning of a linear linked list. Explain the steps with all possibilities**.(UPTU 2012-13)**
4. To represent hierarchical relationship between elements, which data structure is suitable? **(Gate)**

Option A: Dequeue, Option B: Priority Option C: Tree, Option D: All of the above

5. .The min. number of nodes in a binary tree of depth d (root at level 0) is**(Gate)**

Option A: 2d – 1, Option B: 2d Option C: d+1 , Option D: d

TUTORIAL SHEET 6

1. Discuss about tree data structure. Explain different types of binary trees.
2. Define the Huffmans algorithm related to tree with an example and its use.? **(AKTU 2015-16)**
3. Draw the binary trees for the different Algebraic expressions. Take five different examples and also find their preorder traversal**.(UPTU 2008-09)**

4.Consider the In-order and Post-order traversals of a tree as given below : In-order : j e n k o p b f a c l g m d h i Post-order : j n o p k e f b c l m g h i d a The Pre-order traversal of the tree shall be **(Gate)**

Option A: a b f e j k n o p c d g l m h i
Option B: a b c d e f j k n o p g l m h i
Option C: a b e j k n o p f c d g l m h i
Option D: j e n o p k f b c l m g h i d a

5.The post order traversal of a binary tree is DEBFCA. Find out the preorder traversal **(Gate)**
Option A: ABFCDEi
Option B: ADBFEC
Option C: ABDECF
Option D: None of the above

TUTORIAL SHEET 7

1. Discuss about a graph? Explain with examples. Is graph a linear or non linear data structure? **(UPTU 2014-15)**
2 Discuss about Depth First Search? Explain with a suitable example.
3. Explain Minimum Cost spanning tree. Take an example and solve it with Prim's and Kruskal's Algorithm**?(AKTU 2015-16)**
4. Consider an undirected graph G with 100 nodes. The maximum number of edges to be included in G so that the graph is not connected is **(Gate)**
Option A: 2451
Option B: 4950
Option C: **4851**
Option D: 9900
5. A simple graph G with n − vertices is connected if the graph has **(Gate)**
Option A: (n − 1) (n − 2)/2 edges
Option B: **more than (n − 1) (n − 2)/2 edges**
Option C: less than (n − 1) (n − 2)/2 edges
Option D: $\sum^{k}_{(i=1)}$ C(ni, 2) edges

TUTORIAL SHEET 8

1.Explain Activity Network. With an Example**.(UPTU 2013-14)**
2.Explain the Adjacency Matrix representation with an example of graph**.(UPTU 2013-14)**
3. Explain Dijkstra Algorithm.
4. Consider a weighted undirected graph with positive edge weights and let (u, v) be an edge in the graph. It is known that the shortest path from source vertex s to u has weight 53 and shortest path from s to v has weight 65. Which statement is always true? **(Gate)**
Option A: Weight (u, v) < 12 Option B: Weight (u, v) = 12
Option C: Weight (u, v) > 12 Option D: None of the above
5.Consider the following statements : (i) A graph in which there is a unique path between every pair of vertices is a tree. (ii) A connected graph with e = v − 1 is a tree. (iii) A graph with e = v − 1 that has no circuit is a tree. Which of the above statements is/are true ? **(Gate)**
Option A: (i) & (iii) Option B: (ii) & (iii) Option C: (i) & (ii) Option D: **All of the above**

TUTORIAL SHEET 9

1. Explain the Sequential search with an example**.(UPTU 2008-09)**
2. Explain the Binary search with an example**.(AKTU 2015-16)**
3. Give the steps for Selection Sort. Sort the list 32, 17, 57,14,9,23,7,41,5 using this method.
4.Linked Lists are not suitable for _____. **(Gate)**
Option A: **Binary Search**
Option B: Polynomial Manipulation
Option C: Insertion
Option D: Radix Sort

5. A binary search tree is a binary tree : **(Gate)**
Option A: All items in the left sub tree are less than root
Option B: All items in the right sub tree are greater than or equal to the root
Option C: Each sub tree is itself a binary search tree
Option D: **All of the above**

TUTORIAL SHEET 10

1. Give the steps for Quick Sort. Sort the list 32, 17, 57,14,9,23,7,41,5 using this method.
2. Give the steps for radix sort. Sort the list 32, 17, 57,14,9,23,7,41,5 using this method.
3. Discuss about an AVL tree? Explain the details of AVL tree.**(UPTU 2013-14)**
4. Explain the Heap Sort with an example**.(UPTU 2011-12**)
5. In which tree, for every node the height of its left sub tree and right sub tree differ almost by one ? **(Gate)**Options A: Binary search tree , B: AVL tree , C: Threaded Binary Tree , D: Complete Binary Tree

SRMSCET, Bareilly

B.Tech. CS/IT 2nd Year, Batch 2020

Assignment (1)

Data Structure [KCS-301]

Note: Answer all the questions .

- Write an algorithm to insert a node at the end in a circular linked list. Write a program in C to input the elements in a single linked list and display its elements.
- Write an algorithm to add two polynomials when the polynomials are represented using singly linked lists.
- Show the appropriate data structure representation of the following 4x4 matrix

  [{0 ,0, 11, 0},{12, 0 , 0,0},{0,-4,0,0},{0,0,0,-25}]
- Consider an array class[20][50], each element of this array requires 4 bytes of storage. Base address of class is 2000.Determine the location of class[10][10] when the array is stored as –(i) Row- major order, (ii) Column-major order
- Write an algorithm to find the kth element in a sequence of n elements. Mention the limitations of linear array.
- What do you understand by pointers, how is a pointer initialized. How they are useful in programming, explain with suitable example.
- Write a program for deleting kth element from a linear array.
- Differentiate Calloc() and malloc() using suitable example.

- Define data structure .Differentiate between primitive data structure and non primitive data structure. Explain the different ways of analyzing algorithms.
- What do you mean by sparse matrices and its types? write a program to add two sparse matrices?

SRMSCET, Bareilly

B.TECH CS/IT , Batch 2019

Assignment 2

Data Structure(KCS301)

Note: Answer all the questions

1) What do you understand by Recursion. Explain its types with examples. Write a Program in C of Fibonacci Sequence using recursion.
2) What is Tower of Hanoi Problem? Solve it for 4 disks. Draw Recursion Tree and discuss its algorithm.
3) Differentiate Deque and Priority queue. What are applications of Queue DS
4) Why do we need MST? What are two basic Algorithm regarding Minimum Spaning Tree.
5) What is the Difference between Kruskal's and Prim's Algorithm?
6) Write down the steps for the evaluation of postfix expression with example.
7) Write down the C function for insertion and deletion in a linear queue using array.
8) Discuss merge sort. Sort the given array using merge sort

A: 15,10,5,20,25,30,4,35

9) Explain the concept of heap sort? Construct a Max-Heap and Min-Heap from the elements 10, 15, 7, 8, 12, 20, 8, 6. After construction of max heap perform sorting also.

10)Write the short note on the following-

a. Hashing and collision resolution techniques

b. Comparision of all searching and sorting algorithm (Time and Space Complexity)

c. B Tree

MID SEMESTER EXAMINATION-III (2021)
B.TECH 3rd SEMESTER (2019 BATCH) (CS & IT)
DATA STRUCTURE
KCS301 / PAPER ID:

MAX. MARKS: 50 **TIME: 2:00 Hrs.**

ALL QUESTIONS ARE COMPULSORY.

Q1. Attempt all parts of the following: (2 x 7 = 14)

(a) In circular queue Data structure if "Front=Rear" this show:
(i) Queue is empty (ii)Queue is full (iii)Queue is deque (iv)None of these
[CO2]

(b) What is meant by time space trade off?
[CO1]

(c) List the advantages of linked list over arrays.
[CO1]

(d) Which data structure is used to perform recursion?
[CO2]

(e) Write postfix form of the expression (A+B)*(C-D).
[CO2]

(f) List five areas of applications of data structure.
[CO1]

(g) What is time & space complexity of insertion sort?
[CO3]

Q2. Attempt any two parts of the following: (8 x 2 = 16)

(a) (i) Write a program in C for selection sort. Explain its complexity. Sort the following using selection sort method-75,10,20,70,90,80,100.
[CO2]
(ii) How selection sort is different from insertion sort?
[CO2]

(b) (i)Explain linked list data structure. Discuss its advantages & disadvantages. Also discuss various types of linked list with example.

(ii)Write short note on Deques.
[CO2]

(c) (i) Consider 20x5 2D array student which has its base address = 1000 & size of an element = 2. Now compute the address of the element, student [18] [4] assuming that elements are stored in Row Major order.
(ii) Write a program to read & display 3x3 matrix.
[CO1]

Q3. Attempt any four parts of the following: (5 x 4 = 20)

(a) What do you mean by Asymptotic Notations?
[CO1]

(b) Explain Towers of Hanoi Problem for n=3. Write algorithm to calculate total No.

of moves required for three poles A,B & C. Also draw recursion tree.
[CO2]

(c) Explain quick sort algorithm with example.
[CO3]

(d) What do you mean by circular queue? Write algorithm do insert an element

to circular queue.
[CO2]

(e) What do you mean by recursion? Explain its types with example
[CO2]

MID SEMESTER EXAMINATION (2020)
B.TECH 3rd SEMESTER (2019 BATCH) (CS & IT)
DATA STRUCTURE
KCS301 / PAPER ID:

MAX. MARKS: 50 **TIME: 2:00 Hrs.**

ALL QUESTIONS ARE COMPULSORY.

Q1. Attempt all parts of the following: (2 x 7 = 14)

(h) What is the difference between array and linked list? [CO1]

(i) What do you mean by time and space complexity? [CO1]

(j) Define Recursion? Write the statement of tower of Hanoi problem. How many moves are required for n=7. [CO2]

(k) What is queue data structure? How queue is implemented is computer. [CO2]

(l) Differentiate linear search and Binary search techniques? [CO3]

(m) Which design technique is used in Quick Sort algorithm? [CO3]

(n) Compare all the sorting techniques in the basis of their time and space complexities. [CO3]

Q2. Attempt any two parts of the following: (8 x 2 = 16)

(d) Illustrate the use of Stack to convert the following infix expression to Postfix expression –
[CO2]
P : A * (B+C^D) – E^F* (G/H).
Also mention its algorithm.

(e) Write the algorithm for quick sort. Sort the given array using quick sort-
[CO3]
A : 7, 6, 10, 5, 9, 2, 1, 15, 7

(f) How two dimensional array represented in computer memory? Consider a 20×5 two dimensional array class, which has its base address = 1000 and size of the element =2, Now compute the address of element, class [18] [4].
[CO1]
(i) Assuming that elements are stored in row major order.
(ii) Assuming that elements are stored in column major order.

Q3. Attempt any four parts of the following: (5 x 4 = 20)

(f) Suppose an array M contain eight elements as follows, M: 77, 33, 44, 11, 88, 22, 66, 55 Sort this array using Insertion Sort algorithm. Also write a program in C to implement insertion sort algorithm.
[CO3]

(g) Let an array M consist of 13 sorted elements as follows, M: 11, 22, 30, 33, 40, 44, 55, 60, 66, 77, 80, 88, 99.
[CO2]
(i) Search Item = 40 using Binary search algorithm.
(ii) Also write binary search algorithm.

(h) What is Hashing? Define Collision in hashing. Also mention collision Resolution techniques in hashing.
[CO3]

(i) Write the types of linked list and its application. What is the algorithm to insert a new node at the beginning and end of the linked list?
[CO2]

(j) Write short notes on the following:-
[CO1]
(i) Asymptotic notations (ii) Heap Sort

MID SEMESTER EXAMINATION-II (2020)
B.TECH 3rd SEMESTER (2019 BATCH) (CS & IT)
DATA STRUCTURE
KCS301 / PAPER ID:

MAX. MARKS: 50 **TIME: 2:00 Hrs.**

ALL QUESTIONS ARE COMPULSORY.

Q1. Attempt all parts of the following: (2 x 7 = 14)

(o) What is Recursion? How it is different from Tail recursion? [CO2]

(p) Write the Syntax to check whether a given Circular queue is full or empty? [CO2]

(q) Discuss the concept of "Successor" and "Predecessor" in Binary Search Tree. [CO5]

(r) Differentiate between Stack & Queue.
[CO2]

(s) How the graph can be represented in memory? Explain with suitable example.
[CO4]

(t) State the merits and demerits of Static and dynamic memory allocation techniques.
[CO1]

(u) Which Sorting technique is based on "divide and conquer" strategy?
[CO3]

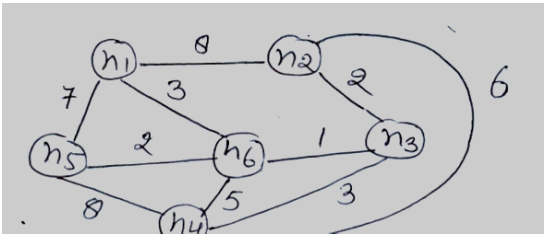
Q2. Attempt any two parts of the following: (8 x 2 = 16)

(g) Consider the following infix expression and convert into reverse polish notation using stack.
[CO2]

A+(B*C-(D|E^F)*H)

Evaluate the expression 12|(7-3)+2*(3+Q)-7 using stack.

(h) Write the Floyad Warshall algorithm to compute the all pair shortest path. Apply the algorithm on following graph:
[CO4]



(i) What is binary tree? Construct a binary tree from given traversals-
[CO5]

Inorder:	D	G	B	E	A	H	F	I	C
Preorder:	A	B	D	G	E	C	F	H	I

Discuss properties of Binary Tree.

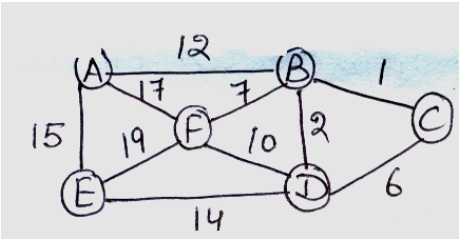
Q3. Attempt any four parts of the following: (5 x 4 = 20)

(k) Why AVL tree is required? Explain balancing factor. Create an AVL search tree from the given set of values- 8, 6, 4, 7, 10, 9, 11, 3, 5, 2, 12
[CO4]

(l) Write the short notes on-
[CO2]

i. Priority queue
ii. Double Ended Queue

(m) Define spanning tree. Also Construct minimum spanning tree using Prim's algorithm for the given graph.
[CO4, 5]



(n) What do you mean by Sorting? Sort the following elements using quick sort-[CO3]

52, 38, 81, 22, 48, 13, 69, 93, 14, 45, 58, 79, 72

Is it a stable sorting algorithm? Justify.

(o) Give the steps for Heap Sort. Sort the list 40, 60, 30, 10, 20, 50 using the heap sort method.
[CO3]

PRE-UNIVERSITY EXAMINATION (2021)

B.TECH 3rd SEMESTER (2019 BATCH) (CS & IT)

DATA STRUCTURE

KCS301 / PAPER ID:

MAX. MARKS: 100 **TIME: 3:00 Hrs.**

Note: Attempt all Sections. If require any missing data; then choose suitably**.**

SECTION - A

1. Attempt all questions in brief. **2 x 10 = 20**

(v) Write down parameters for judging the efficiency of an algorithm. [CO1]

(w) Explain Transitive closure of a graph with example. [CO5]

(x) What do you mean by Data Structure? Give the difference between linear & non-linear data structures.
[CO1]

(y) What is Priority Queue?
[CO2]

(z) Draw a binary tree for the expression:
[CO4]
A * B - (C + D) * (P / Q)

(aa) What do you mean by stack? Write conditions for stack overflow & stack underflow.
[CO2]

(bb) Explain Big Oh(O) Notation.
[CO1]

(cc) Differentiate between Trees & Graphs.
[CO5]

(dd) What is a Recursion? Discuss with example.
[CO1]

(ee) What do you mean by dynamic memory allocation & static Memory allocation?
[CO1]

SECTION -B

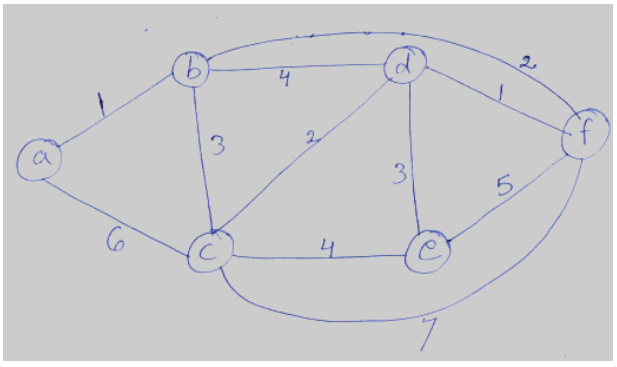
2. Attempt any three parts of the following: 10 x 3 = 30

(j) Write algorithm to convert infix expression to Postfix expression. Illustrate the use of stack to convert the following infix expression to postfix expression.
[CO2]

P: A * (B + C ^ D) – E ^ F * (G / H)

(k) Explain Huffman algorithm. Construct Huffman Tree for MAHARASHTRA with optimal code.
[CO4]

(l) Write Prism's algorithm & find the minimum spanning tree for following graph.
[CO4]



(m) An array DSC [50] [60] is stored in row major order with each element occupies 2 bytes of memory & address of DSC [12] [34] is started at location 1000. Find the address of CS [34] [56]. Assume array index starting with '1'.
[CO1]

(n) What is Merge Sort? Write a program in C of merge sort. Sort the given data using merge sort algorithm. What is its complexity?
[CO3]
39, 9, 81, 45, 90, 27, 72, 18.

SECTION - C

3. Attempt any one part of the following: 10 x 1 = 10

(a) A Hash function H defined as H(Key) = Key%7, The Linear probing, is used to insert the key 37, 38, 72, 48, 98, 11, 56 into a table indexed from 0 to 6. What will be the location of key 11? Justify your answer, Also count total no. of collision in this Probing.
[CO4]

(b) Write short notes on the following;
[CO2]
i. Tower of Hanoi Problem
ii. Threaded Binary Tree

4. Attempt any one part of the following: 10 x 1 = 10

(p) Differentiate between array & linked list. Write a program in C to insert & delete node from singly link list.
[CO1]

(q) (i) Construct the Binary Tree for the following:-
In-order: Q, B, K, C, F, A, G, P, E, D, H, R
Preorder: G, B, Q, A, C, K, F, P, D, E, R, H
[CO2]
(ii) Also find Post order Traversal of the tree.

5. Attempt any one part of the following: 10 x 1 = 10

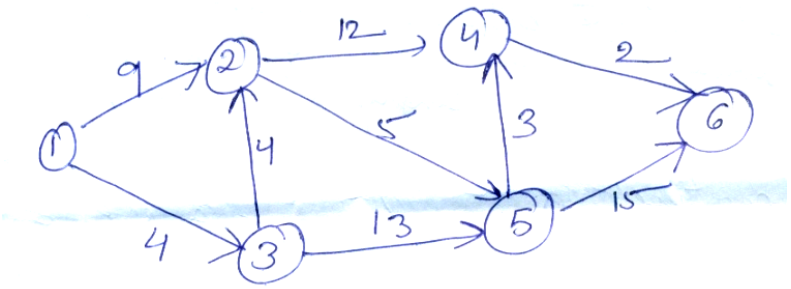
(a) What is AVL Tree? Why height balancing of Tree is required? Crete an AVL Tree for the following Elements:
[CO1]
A, Z, B, Y, C, X, D, W, E, V, F

(b) Write a program to search an element in an array using Binary Search. Support an array A [ ] whose elements are A = {5, 8, 15, 25, 30, 40, 55}. Search the data 30 using Binary Search Techniques.
[CO]

6. Attempt any one part of the following: 10 x 1= 10

(a) Write a program to sort an array using insertion sort. Sort the array given below using Insertion sort. 39, 9, 81, 45, 90, 27, 72, 18
[CO]

(b) Write Dijikstra's algorithm. By considering vertex 1 as source vertex, find path to all other veritices in the following graph. Using Dijkstra's algorithm. Show all steps. [CO]



7. Attempt any one part of the following: 10 x 1= 10

(a) Write short Notes on the following:-
[CO]
i. B-Trees with example
ii. Kruskal's algorithm with example

(b) Write short notes on the following:-
[CO]
i. Breadth First Search Algorithm
ii. Double Ended Queue

PRE-UNIVERSITY EXAMINATION (2021)
B.TECH 3rd SEMESTER (2019 BATCH) (CS & IT)
DATA STRUCTURE
KCS301 / PAPER ID:

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Note: Attempt all Sections. If require any missing data; then choose suitably**.**

SECTION - A

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(gg) Explain Transitive closure of a graph with example. [CO5]

(hh) What do you mean by Data Structure? Give the difference between linear & non-linear data structures. [CO1]

(ii) What is Priority Queue? [CO2]

(jj) Draw a binary tree for the expression: [CO4]

A * B - (C + D) * (P / Q)

(kk) What do you mean by stack? Write conditions for stack overflow & stack underflow. [CO2]

(ll) Explain Big Oh(O) Notation. [CO1]

(mm) Differentiate between Trees & Graphs. [CO5]

(nn) What is a Recursion? Discuss with example. [CO1]

(oo) What do you mean by dynamic memory allocation & static Memory allocation? [CO1]

SECTION -B

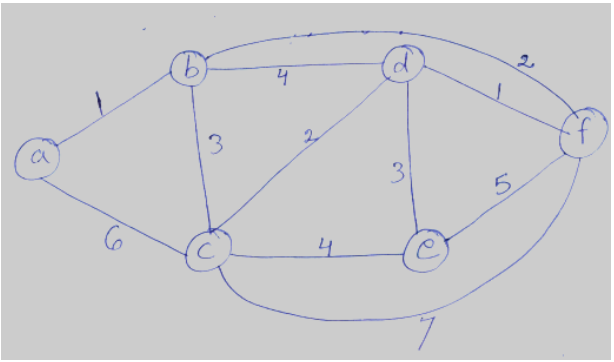
2. Attempt any three parts of the following: **10 x 3 = 30**

(o) Write algorithm to convert infix expression to Postfix expression. Illustrate the use of stack to convert the following infix expression to postfix expression. [CO2]

P: A * (B + C ^ D) – E ^ F * (G / H)

(p) Explain Huffman algorithm. Construct Huffman Tree for MAHARASHTRA with optimal code. [CO4]

(q) Write Prism's algorithm & find the minimum spanning tree for following graph. [CO4]



(r) An array DSC [50] [60] is stored in row major order with each element occupies 2 bytes of memory & address of DSC [12] [34] is started at location 1000. Find the address of CS [34] [56]. Assume array index starting with '1'.
[CO1]

(s) What is Merge Sort? Write a program in C of merge sort. Sort the given data using merge sort algorithm. What is its complexity?
[CO3]
39, 9, 81, 45, 90, 27, 72, 18.

SECTION - C

3. Attempt any one part of the following: 10 x 1 = 10

(c) A Hash function H defined as H(Key) = Key%7, The Linear probing, is used to insert the key 37, 38, 72, 48, 98, 11, 56 into a table indexed from 0 to 6. What will be the location of key 11? Justify your answer, Also count total no. of collision in this Probing.
[CO4]

(d) Write short notes on the following;
[CO2]
iii. Tower of Hanoi Problem
iv. Threaded Binary Tree

4. Attempt any one part of the following: 10 x 1 = 10

(r) Differentiate between array & linked list. Write a program in C to insert & delete node from singly link list.
[CO1]

(s) (i) Construct the Binary Tree for the following:-
In-order: Q, B, K, C, F, A, G, P, E, D, H, R
Preorder: G, B, Q, A, C, K, F, P, D, E, R, H
[CO2]
(ii) Also find Post order Traversal of the tree.

5. Attempt any one part of the following: 10 x 1 = 10

(c) What is AVL Tree? Why height balancing of Tree is required? Crete an AVL Tree for the following Elements:
[CO1]
A, Z, B, Y, C, X, D, W, E, V, F

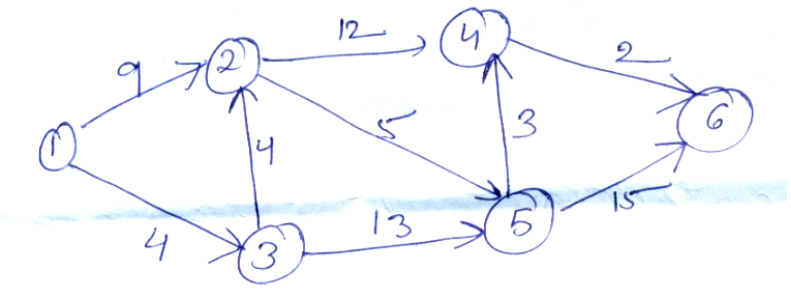
(d) Write a program to search an element in an array using Binary Search. Support an array A [ ] whose elements are A = {5, 8, 15, 25, 30, 40, 55}. Search the data

30 using Binary Search Techniques.
[CO]

6. Attempt any one part of the following: 10 x 1= 10

(c) Write a program to sort an array using insertion sort. Sort the array given below using Insertion sort. 39, 9, 81, 45, 90, 27, 72, 18
[CO]

(d) Write Dijikstra's algorithm. By considering vertex 1 as source vertex, find path to all other veritices in the following graph. Using Dijkstra's algorithm. Show all steps. [CO]



7. Attempt any one part of the following: 10 x 1= 10

(c) Write short Notes on the following:-
[CO]
iii. B-Trees with example
iv. Kruskal's algorithm with example

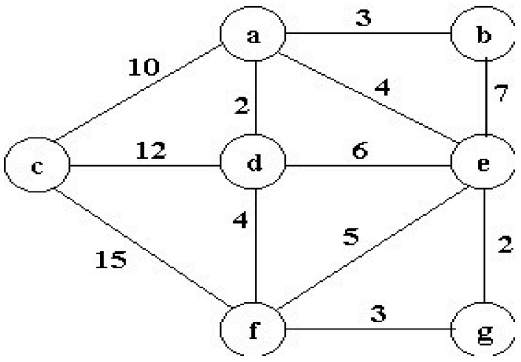
(d) Write short notes on the following:-
[CO]
iii. Breadth First Search Algorithm
iv. Double Ended Queue

MODEL PAPER
(SEM. III) ODD SEMESTER EXAMINATION 2019-20
DATA STRUCTURES

Time 3 Hours **Total Marks 70**

Note: Attempt all sections. If requires any missing data; then choose suitably

1. **Attempt all questions in brief.**
   2x7=14
   a) Differentiate Data Structure and Data Type.
   b) What do you mean by Tail recursion?
   c) What is Compaction?
   d) Write the basic concept of KRUSKAL's algorithm.
   e) Write over flow conditions for a circular queue.
   f) Describe the space and time complexities of a program are necessary.
   g) Obtain an addressing formula for the element $A[i_1][i_2]\ldots.[i_n]$ in an n-dimensional array declared as $A[u_1][u_2]\ldots.[u_n]$, Assume a column major representation of the array with one word per element.
2. **Attempt any three of the following.** **7x3=21**
   a) Write a function in C which searches string X for the first occurrence of string Y. If Y does not appear in X, then function returns zero. Otherwise function returns starting position in X of the first occurrence of Y.
   b) Write an algorithm for evaluating an expression in postfix form.
   c) State the Towers of Hanoi problem. Write a recursive algorithm for solving this problem when the numbers of disk are three.
   d) If the in-order traversal of a binary tree is B,I,D,A,C,Q,E,H,F and its postorder traversal is I,D,B,Q,C,H,F,E,A, determine the binary tree.
   e) Write a program in C for binary search. What is the worst case time complexity of binary search?
3. **Attempt any one part of the following.** **7x1=7**
   a) Write an algorithm to add two polynomials when the polynomials are represented using singly linked lists.
   b) Illustrate the quick sort algorithm on list 9,20,12,21,3,5,1,22,19,7.
4. **Attempt any one part of the following.** **7x1=7**
   a) Discuss the different cases of rotations in AVL trees.
   b) Use Prim's algorithm to determine the minimum spanning tree of the graph given below:



5. **Attempt any one part of the following.** **7x1=7**
   a) Explain Dijkstra's Algorithm and illustrate it on a suitable graph.
   b) Implement typical stack operation when stacks are represented using singly linked lists.
6. **Attempt any one part of the following.** **7x1=7**
   a) Write an algorithm to insert and delete a node from doubly linked list.
   b) Write an algorithm to convert a valid arithmetic infix expression into its equivalent postfix expression. Trace your algorithm for A-B/C+D*E+F.
7. **Attempt any one part of the following.** **7x1=7**

a) State the merits and demerits of static and dynamic memory allocation techniques.
b) Write short notes on any two :
   (i) Direct file organization
   (ii) Priority Queue
   (iii) Indexing.