Swami Keshvanand Institute of Technology, Management &Gramothan,
Ramnagaria, Jagatpura, Jaipur-302017, INDIA
Approved by AICTE, Ministry of HRD, Government of India
Recognized by UGC under Section 2(f) of the UGC Act, 1956
Tel. : +91-0141- 5160400Fax: +91-0141-2759555
E-mail: info@skit.ac.in Web: www.skit.ac.in

A

Course File

On

(Data Structure and Algorithms3CS4-05)

Programme: B.Tech

Semester: III

Session: 2022-23

(Mani Butwall)
(Assistant Professor)
(CSE)

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Contents

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Vision and Mission of Institute

Vision: "To promote higher learning in technology and industrial research to make our country a global player."

Mission: "To promote quality education, training and research in the field of engineering by establishing effective interface with industry and to encourage the faculty to undertake industry sponsored projects for the students."

Quality Policy

We are committed to **'achievement of quality'** as an integral part of our institutional policy by continuous self-evaluation and striving to improve ourselves.

Institute would pursue quality in

- All its endeavours like admissions, teaching- learning processes, examinations, extra and co-curricular activities, industry institution interaction, research & development, continuing education, and consultancy.
- Functional areas like teaching departments, Training & Placement Cell, library, administrative office, accounts office, hostels, canteen, security services, transport, maintenance section and all other services."

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Vision of CSE Department

Vision of CSE department is to:

V1: Produce quality computer engineers trained in latest tools and technologies.

V2: Be a leading department in the region and country by imparting in-depth knowledge to the students in emerging technologies in computer science & engineering.

Mission of CSE Department

Mission of CSE department is to:

Deliver resources in IT enable domain through:

M1: Effective Industry interaction and project-based learning.

M2: Motivating our students for employability, entrepreneurship, research and higher education.

M3: Providing excellent engineering skills in a state-of-the art infrastructure.

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Program Educational Objectives of CSE department

The graduates of CSE program will be:
PEO1: Prepared to be employed in IT industries and be engaged in learning, understanding, and applying new ideas.
PEO2: Prepared to be responsible professionals in their domain of interest.
PEO3: Able to apply their technical knowledge as practicing professionals or engaged in higher education.
PEO4: Able to work efficiently as an individual and in a professional team environment.

Program Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis, and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
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.

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Program Specific Outcomes

PSO1: Core Engineering Skills: Exhibit fundamental concepts of Data Structures, Databases, Operating Systems, Computer networks, Theory of Computation, Advanced Programming, and Software Engineering.

PSO2: Standard Software Engineering practices: Demonstrate an ability to design, develop, test, debug, deploy, analyze, troubleshoot, maintain, manage and secure software.

PSO3: Future Endeavors: Recognize the need to have knowledge of higher education institutions/ organizations/ companies related to computer science & engineering.

RTU Scheme & Syllabus

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Teaching & Examination Scheme
B.Tech. : Computer Science & Engineering
2nd Year - III Semester

SN	Category	Course Code	Course Title	Contact hrs/week L	T	P	Marks Exm Hrs	IA	ETE	Total	Cr
THEORY											
1	BSC	3CS2-01	Advanced Engineering Mathematics	3	0	0	3	30	70	100	3
2	HSMC	3CS1-02/ 3CS1-03	Technical Communication/ Managerial Economics and Financial Accounting	2	0	0	2	30	70	100	2
3	ESC	3CS3-04	Digital Electronics	3	0	0	3	30	70	100	3
4	PCC	3CS4-05	Data Structures and Algorithms	3	0	0	3	30	70	100	3
5		3CS4-06	Object Oriented Programming	3	0	0	3	30	70	100	3
6		3CS4-07	Software Engineering	3	0	0	3	30	70	100	3
			Sub Total	**17**	**0**	**0**					**17**
PRACTICAL & SESSIONAL											
7	PCC	3CS4-21	Data Structures and Algorithms Lab	0	0	3		60	40	100	1.5
8		3CS4-22	Object Oriented Programming Lab	0	0	3		60	40	100	1.5
9		3CS4-23	Software Engineering Lab	0	0	3		60	40	100	1.5
10		3CS4-24	Digital Electronics Lab	0	0	3		60	40	100	1.5
11	PSIT	3CS7-30	Industrial Training	0	0	1		60	40	100	1
12	SODECA	3CS8-00	Social Outreach, Discipline & Extra Curricular Activities							100	0.5
			Sub- Total	**0**	**0**	**13**					**7.5**
			TOTAL OF III SEMESTER	**17**	**0**	**13**					**24.5**

L: *Lecture,* ***T:*** *Tutorial,* ***P:*** *Practical,* ***Cr:*** *Credits*

ETE: *End Term Exam,* ***IA:*** *Internal Assessment*

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

II Year-III Semester: B.Tech. Computer Science and Engineering

3CS4-05: Data Structures and Algorithms

Credit-3
3L+0T+0P

Max. Marks: 100 (IA:30, ETE:70)
End Term Exam: 3 Hours

SN	CONTENTS	Hours
1	Stacks: Basic Stack Operations, Representation of a Stack using Static Array and Dynamic Array, Multiple stack implementation using single array, Stack Applications: Reversing list, Factorial Calculation, Infix to postfix Transformation, Evaluating Arithmetic Expressions and Towers of Hanoi.	8
2	Queues: Basic Queue Operations, Representation of a Queue using array, Implementation of Queue Operations using Stack, Applications of Queues- Round Robin Algorithm. Circular Queues, DeQueue Priority Queues. Linked Lists:Introduction, single linked list, representation of a linked list in memory, Different Operations on a Single linked list, Reversing a single linked list, Advantages and disadvantages of single linked list, circular linked list, double linked list and Header linked list.	10
3	Searching Techniques: Sequential and binary search.Sorting Techniques: Basic concepts, Sorting by: bubble sort, Insertion sort, selection sort, quick sort, heap sort, merge sort, radix sort and counting sorting algorithms.	7
4	Trees: Definition of tree, Properties of tree, Binary Tree, Representation of Binary trees using arrays and linked lists, Operations on a Binary Tree, Binary Tree Traversals (recursive), Binary search tree, B-tree , B+ tree, AVL tree, Threaded binary tree.	7
5	Graphs: Basic concepts, Different representations of Graphs, Graph Traversals (BFS & DFS), Minimum Spanning Tree(Prims &Kruskal), Dijkstra's shortest path algorithms.Hashing: Hash function, Address calculation techniques, Common hashing functions, Collision resolution: Linear and Quadratic probing, Double hashing.	8
	TOTAL	**40**

Prerequisite of Course

- Knowledge of programming languages, basics of mathematics, organising and problem-solving ability. Data structures and algorithms are some fields where you need skills and abilities before advancing.

- Basic knowledge of Programming Language (C, C++, Java, Python, etc.)
- In-depth knowledge of various data types, variables, arrays, pointers, operators, and strings.

List of Text and Reference Books

1. Introduction to Algorithms, **Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein.**
2. Algorithms by Robert Sedgewick& Kevin Wayne
3. Data Structures by **Seymour Lipschutz (Schaum's Outlines)**

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Time Table

	1	2	3	4	5	6	7
	8:00-9:00	**9:00-10:00**	**10:00-11:00**	**11:00-11:30**	**11:30-12:30**	**12:30-1:30**	**1:30-2:30**
Monday					3CS–AI (B) DSA(Lecture) 306		
Tuesday	3CS (DS) A–G2 DSA Lab (Lab) Computer Lab 15 (2nd Floor)				3CS–DS (A) DSA(Lecture) 302		
Wednesday		3CS–AI (B) DSA(Lecture) 306					
Thursday			3CS–AI (B) DSA(Lecture) 306		3CS–DS (A) DSA(Lecture) 302		
Friday	3CS (DS) A–G1 DSA Lab (Lab) Computer Lab 1 (3rd Floor)				3CS–DS (A) DSA(Lecture) 301	3CSC– G1 ITR Lab (Lab) Computer Lab 3 (3rd Floor)	
Saturday	3CSA – G2 DSA Lab (Lab) Computer Lab 15 (2nd Floor)						

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Syllabus Deployment: Course Plan & Coverage

S.No.	Unit	Course coverage
1	**UNIT-1**	**Objective of Course**
2		DSA Introduction, Algorithm
2		Space and Time Complexity
3		Stacks: Basic Stack Operations, Representation of a Stack using Static Array
4		Multiple stack implementation using single array
5	**UNIT-2**	Stack Applications: Reversing list, Factorial Calculation,
6		Infix to postfix Transformation algorithm
7		Infix to postfix , prefix Transformation example
8		Evaluating Arithmetic Expressions, Towers of Hanoi algorithm
11		Representation of a Stack using Dynamic Array
12		Queues: Basic Queue Operations, Representation of a Queue using array
13		Implementation of Queue Operations using Stack
14		Circular Queues, DeQueue, Priority Queues
15		Implementation of Queue Operations using Linked List
16		Linked Lists: Introduction, difference between array and linked list
17	UNIT-2	single linked list, representation of a linked list in
		memory, Different Operations on a Single linked list,
18		Insertion algorithms in Single linked list, Deletion algorithms in Single linked list
19		Insertion algorithms in doubly linked list, Deletion algorithms in doubly linked list
20		Insertion algorithms in circular linked list, Deletion algorithms in circular linked list
21		Reversing a single linked list, Header linked list,Insertion algorithms in Single linked list
23		Searching Techniques: Sequential and binary search
24		bubble sort,selection sort,
25	UNIT-3	Insertion sort, quick sort
26		merge sort, radix sort
27		Counting sorting algorithms.

28	UNIT-4	Introduction of Trees,Types of trees
29		Representation of Trees, Operation of binary tree
30		Traversal algorithm
31		Tree traversal- Inorder, Preordere, Postorder
32		Binary search Tree, B Tree, B+ tree
33		Threaded binary tree
34		AVL TREE rotations
35	UNIT-5	Graph Introduction, Traversal
36		Minimum Spanning Tree(Prims), Kruskal
37		Dijkstras Shortest Path
38		Hashing, Address calculation technique

Total No of Lectures Required: 38

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Course Coverage

Lecture No.	Date	Topic(s) Covered
1	10.08.2022	DSAIntroduction,Algorithm, Spaceand TimeComplexity
2	16.08.2022	Algorithm, formation & Analysis
3	17.08.2022	Array data structure, Introduction & Analysis
4	20.08.2022	Insertion & Deletion in Array
5	23.08.2022	2-D array representation & Operation
6	30.08.2022	Sparse Matrix
7	03.09.2022	Stack-Introduction & Push-Pop Operation
8	06.09.2022	Applications of Stack-expression evaluation
9	07.09.2022	Reversal of String, nesting of parenthesis
10	08.09.2022	Conversion of notations using stack
11	10.09.2022	Practice questions on conversion of notations
12	13.09.2022	Tower of Hanoi (Recursion)
13	14.09.2022	Queue Data Structure
14	17.09.2022	Circular Queue and DE queue
15	20.09.2022	Linked List:- Introduction, Difference b/w array & linked list
16.	21.09.2022	Singly Linked List and its Operations
17.	24.09.2022	Doubly Linked List and its Operations
18.	01.10.2022	Circular Linked List and its Operations

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Course Coverage

Lecture No.	Date	Topic(s) Covered
19	04.10.2022	Doubly Circular Linked List and its operations
20	05.10.2022	Reversing a singly linked list
21	08.10.2022	Header Linked List
22	12.10.2022	Searching- Linear Search & Binary Search
23	15.10.2022	Sorting:- Bubble Sort
24	18.10.2022	Insertion Sort
25	19.10.2022	Selection Sort
26	01.11.2022	Quick Sort
27	02.11.2022	Merge Sort
28	05.11.2022	Radix Sort & Counting Sort
29	08.11.2022	Introduction to Tree and its type
30	09.11.2022	Binary Tree with its Operations
31	12.11.2022	Binary Search Tree with its Operations
32	15.11.2022	AVL Tree & its Rotations
33	16.11.2022	AVL Tree Operations
34	19.11.2022	Introduction to B-Tree & Its Operation
35	22.11.2022	B+-Tree & Its Operation
36	26.11.2022	Threaded Binary Tree & Graph Introduction

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Lecture No.	Date	Topic(s) Covered
37	29.11.2022	Graph Traversal (BFS & DFS)
38	02.12.2022	Minimum Spanning Tree
39	10.12.2022	Dijkstra's Shortest Path Algorithm & Hashing Technique
40	13.12.2022	Address Calculation Technique
		Beyond Syllabus Topics
41	15.12.2022	Red-Black Tree
42	16.12.2022	Complexity Evaluation

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Program Outcomes/Program Specific Outcomes – Indicators - Competencies

Program Outcome/Program Specific Outcome	Indicator	Competency
PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.	1.1.1	Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems
	1.1.2	Apply advanced mathematical techniques to model and solve computer science & engineering problems
	1.2.1	Apply laws of natural science to an engineering problem
	1.3.1	Apply fundamental engineering concepts to solve engineering problems
	1.4.1	Apply computer science & engineering concepts to solve engineering problems.
PO 2: Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2.1.1	Articulate problem statements and identify objectives
	2.1.2	Identify engineering systems, variables, and parameters to solve the problems
	2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
	2.2.1	Reframe complex problems into interconnected sub-problems
	2.2.2	problems Identify, assemble and evaluate information
	2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions
	2.2.4	Compare and contrast alternative solution processes to select the best process.
	2.3.1	Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy.
	2.3.2	Identify assumptions (mathematical and physical) necessary to allow modeling of a system at the level of accuracy required.
	2.4.1	Apply engineering mathematics and computations to solve mathematical models
	2.4.2	Produce and validate results through skilful use of contemporary engineering tools and models
	2.4.3	Identify sources of error in the solution process, and limitations of the solution.
	2.4.4	Extract desired understanding and conclusions consistent with objectives and limitations of the analysis
PO 3: Design/Development of Solutions:	3.1.1	Recognize that need analysis is key to good

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.		problem definition
	3.1.2	Elicit and document, engineering requirements from stakeholders
	3.1.3	Synthesize engineering requirements from a review of the state-of-the-art
	3.1.4	Extract engineering requirements from relevant engineering Codes and Standards such as IEEE, ACM, ISO etc.
	3.1.5	Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues
	3.1.6	Determine design objectives, functional requirements and arrive at specifications
	3.2.1	Apply formal idea generation tools to develop multiple engineering design solutions
	3.2.2	Build models/prototypes to develop diverse set of design solutions
	3.2.3	Identify suitable criteria for evaluation of alternate design solutions
	3.3.1	Apply formal decision making tools to select optimal engineering design solutions for further development
	3.3.2	Consult with domain experts and stakeholders to select candidate engineering design solution for further development
	3.4.1	Refine a conceptual design into a detailed design within the existing constraints (of the resources)
	3.4.2	Generate information through appropriate tests to improve or revise design
PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	4.1.1	Define a problem, its scope and importance for purposes of investigation
	4.1.2	Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation
	4.1.3	Apply appropriate instrumentation and/or software tools to make measurements of physical quantities
	4.1.4	Establish a relationship between measured data and underlying physical principles.
	4.2.1	Design and develop experimental approach, specify appropriate equipment and procedures
	4.2.2	Understand the importance of statistical design of experiments and choose an appropriate experimental design plan based on the study objectives
	4.3.1	Use appropriate procedures, tools and

		techniques to conduct experiments and collect data
	4.3.2	Analyze data for trends and correlations, stating possible errors and limitations
	4.3.3	Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions
	4.3.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions
PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	5.1.1	Identify modern engineering tools, techniques and resources for engineering activities
	5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
	5.2.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modelling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
	5.2.2	Demonstrate proficiency in using discipline specific tools
	5.3.1	Discuss limitations and validate tools, techniques and resources
	5.3.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.
PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at global, regional and local level
	6.2.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public
PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	7.1.1	Identify risks/impacts in the life-cycle of an engineering product or activity
	7.1.2	Understand the relationship between the technical, socio economic and environmental dimensions of sustainability
	7.2.1	Describe management techniques for sustainable development
	7.2.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline
PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	8.1.1	Identify situations of unethical professional conduct and propose ethical alternatives
	8.2.1	Identify tenets of the ASME professional code of ethics

	8.2.2	Examine and apply moral & ethical principles to known case studies
PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	9.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
	9.1.2	Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
	9.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills
	9.2.2	Treat other team members respectfully
	9.2.3	Listen to other members
	9.2.4	Maintain composure in difficult situations
	9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	10.1.1	Read, understand and interpret technical and non-technical information
	10.1.2	Produce clear, well-constructed, and well-supported written engineering documents
	10.1.3	Create flow in a document or presentation
	10.2.1	Listen to and comprehend information, instructions, and viewpoints of others
	10.2.2	Deliver effective oral presentations to technical and non- technical audiences
	10.3.1	Create engineering-standard figures, reports and drawings to complement writing and presentations
	10.3.2	Use a variety of media effectively to convey a message in a document or a presentation
PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	11.1.1	Describe various economic and financial costs/benefits of an engineering activity
	11.1.2	Analyze different forms of financial statements to evaluate the financial status of an engineering project
	11.2.1	Analyze and select the most appropriate proposal based on economic and financial considerations.
	11.3.1	Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks.
	11.3.2	Use project management tools to schedule an engineering project so it is completed on time and on budget.
PO 12: Life-long learning: Recognise the need for, and have the preparation and	12.1.1	Describe the rationale for requirement for continuing professional development

ability to engage in independent and life-long learning in the broadest context of technological change.	12.1.2	Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
	12.2.1	Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current
	12.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field
	12.3.1	Source and comprehend technical literature and other credible sources of information
	12.3.2	Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.
PSO1: Core Engineering Skills: Exhibit fundamental concepts of Data Structures, Databases, Operating Systems, Computer Network, Theory of Computation, Advanced Programming and Software Engineering.	PSO1.1.1	Possess the concepts of Data Structure and Database Management System
	PSO1.1.2	Possess the concepts of core engineering subjects including Operating System, Computer Networks and Software Engineering.
	PSO1.1.3	Apply basic programming skills to solve real world problems
PSO2: Standard Software Engineering practices: Demonstrate an ability to design, develop, test, debug, deploy, analyze, troubleshoot, maintain, manage and secure a software.	PSO2.1.1	Apply fundamental software engineering concepts to solve real world problem
	PSO2.1.2	Possess conceptual knowledge for designing, analysing and testing a software
	PSO2.1.3	Estimate and evaluate the cost related to a Software
PSO3: Future Endeavors: Recognize the need to have knowledge of higher education institutions/ organizations/ companies related to computer science & engineering.	PSO3.1.1	Explore the need of current technology being practised by computer science industry/ institutions.
	PSO3.1.2	Identify the requirement of continuing education through postgraduation like M.Tech., MS, MBA etc.
	PSO3.1.3	List various higher education institutes and organizations related to computer science & engineering.

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CO-PO/PSO Mapping

Programme:B.Tech.

Branch :Computer Science&Engineering

Semester:III

CourseName(Course Code):DataStructures andAlgorithms (3CS4-05)

CourseOutcomes

Aftercompletionofthiscourse,students willbeable to –

3CS4-05.1	***Design***applicationsusingstacksandvarioustypesofqueues
3CS4-05.2	***Analyze***andapply**o**perationsof linkedlistsand ***demonstrate*** theirapplications
3CS4-05.3	***Evaluate*** the computational efficiency of the principal algorithms for sorting,searching,and hashing.
3CS4-05.4	***Demonstrate***operationsontreesand ***discuss***varioustypesofTrees.
3CS4-05.5	***Identify,*** model, solve and develop algorithms for real life problems like shortest pathandMST using graph theory.

NameofFaculty:(Sig
nature)

Verifiedby CourseCoordinator

Signature Name:

VerifiedbyVerificationandValidationCommittee,DPAQIC

Signature

Name:

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CO-PO/PSO Mapping

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CO-PO/PSOMapping:FormulationandJustification

TheCO-PO/PSOmappingis based onthecorrelationofcourseoutcome(CO)withProgramOutcomeIndicators.Theseindicator sarethe breakupstatementsofbroadProgramOutcomestatement.

The correlation is calculated as number of correlated indicators of a PO/PSO mapped with CO divided by total indicators of aPO/PSO.Thecalculatedvaluerepresentsthecorrelationlevelbetweena CO&PO/PSO. Detailedformulationandmathematicalrepresentationcanbeseenbelowinequation1:

Input: CO_i: *Theithcourseoutcomeofthecourse*

PO_j: *ThejthProgramOutcome*

I_{jk}: *Thekthindicatorof thejthProgramOutcome*

$\langle(I_{jk}, CO_i)$: *level ofCO-POmapping*

=1,if,0<⟨<0.33

=2,if,0.33≥⟨<0.66

=3,if,0.66≥⟨<1

$$\alpha(I_{jk},CO_i) = \frac{count(\lambda(I_{jk},CO_i))}{count(I_k,PO_j)}$$

⌊*:Degreeofcorrelation*

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CO-PO/PSOMapping

Programme: BTech

Branch :Computer Science&Engimneering

Semester: III

CourseName(CourseCode):DataStructuresandAlgorithms(3CCS4-05)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	2	1	3					2			3	2	
CO2		2	2	1	3								3	2	
CO3	2	2	2	2	3		3	2	3	2	2	2	3	3	
CO4	2	2	2	3	3		3	2	3	2	2	2	3	3	
CO5	2	2	2	2	3		3	2	3	2	2	2	3	3	

NameofFaculty: Rajesh Rajaan

(Signature)

Verified byCourse Coordinator

Signature

(Name:……..)

VerifiedbyVerificationandValidationCommittee,DPAQIC

Signature

(Name

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Teaching-Learning Methodology

1. Teaching many of the concepts of Data Structures and Algorithms traditional Chalk and Talk method produces incomprehension, boredom, and glazed eye among the student

2.Topics will be covered essentially through plenty of examples. Lecture classes areconducted as lecture-

cum-tutorial classes.

3. For the better understanding of concepts innovative teaching methods like activity, analogy, role play and brainstorming are used.

4. It is a course that aims to develop Knowledge about Data Structure.

5. The teacher is not depending on a single or a set of two or three text books.

6. Use of Power Point Presentations, hand written course notes, video lectures will be doneto communicate

with students.

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RTU Papers (Previous Years

RTU paper

Roll No. _____ [Total No. of Pages : 2

3E1652/1612

B.Tech. IIISem.(Main/Back) Examination Dec. - 2016
Computer Science & Engineering.
3CS2A Data Structures and Algorithms
CS,IT,EX,EC, EI

Time : 3 Hours **Maximum Marks : 80**
Min. Passing Marks : 26

Instructions to Candidates:

*Attempt any **five** questions, selecting **one question** from **each unit**. All questions carry equal marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.*

Unit - I

1. a) What are the differences between Big oh (O), omega (Ω) & theta (θ) notation? **(8)**

   b) Calculate the address of element A[3][2] in a two dimensional array. A[3][3] stored in row major and column major order in the main memory. Assume the base address to be 100 and that each element requires 2 words of storage. **(8)**

OR

1. a) Why time and space complexity must be considered while writing a code? **(8)**

   b) Explain the characteristics of an algorithm. **(8)**

Unit - II

2. a) What is STACK? Write algorithms to insert an element in STACK and delete an element from STACK with example. **(8)**

   b) Convert following infix expression into portfix notation :

   $A+B-(C+D)/E*F-(G+h)/I$ **(8)**

OR

2. a) Explain the implementation of queue with example. **(8)**

   b) Write an algorithm to delete an element from a circular queue. **(8)**

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Unit - III

3. What is doubly linked list? Explain the algorithms for inserting a node and deleting a node from a doubly linked list. **(16)**

OR

3. a) Explain polynomial representation using linked list with an example. **(8)**

   b) What is dequeue? Write down the algorithms for the insertion and deletion operations performed on dequeue. **(8)**

Unit - IV

4. a) Define Binary search tree. Write algorithm to implement insertion operation on Binary Search tree. **(8)**

   b) What is an AVL tree? Explain the rotations of AVL tree. **(8)**

OR

4. a) Explain an algorithm for postorder traversal of a binary tree. **(8)**

   b) What are the basic operations that can be performed on a binary tree? Explain each of them in detail with suitable example. **(8)**

Unit - V

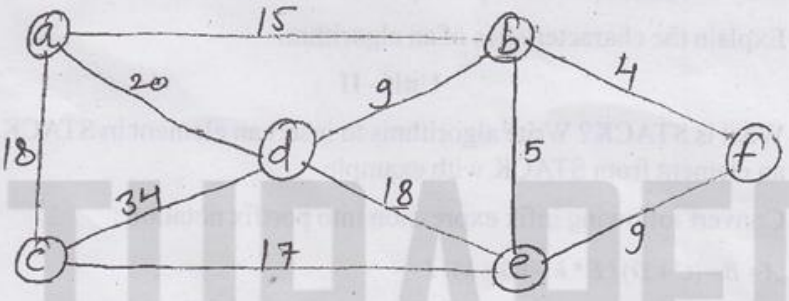
5. a) Write an algorithm for merge sort and comment on its complexity. **(8)**

   b) Sort the following data in ascending order using Quick sort :

   9, 4, 12, 6, 5, 10, 7. **(8)**

OR

5. a) Using Prim's and Kruskal's algorithm, find minimum spanning tree for the following graph : **(10)**



   b) Write an algorithm for DFS traversal. **(6)**

RTU paper

(b) Explain with a suitable example the principle of operation of heap sort. [4]

OR

Q.5 (a) What is sorting? Write an algorithm to sort the real numbers using insertion sort and selection sort. What is the time complexity for both selection and insertion sort? [2+8+2=12]

(b) What is difference between an internal sorting and external sorting? [4]

3E1652

Roll No. ________ Total No of Pages: 4

3E1652

B. Tech III Sem. (Main/Back) Exam. Jan. 2016
Computer Engineering & Information Technology
3CS2A & 3IT2A Data Structures and Algorithms
Common for EX, EC, EI

Time: 3 Hours **Maximum Marks: 80**
Min. Passing Marks: 24

Instructions to Candidates:

*Attempt any **five questions**, selecting **one question** from **each unit**. All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.*

Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

UNIT-I

Q.1 (a) What is an Algorithm? Explain time and space analysis of an algorithm with suitable example. [8]

(b) What do you understand by best, worst and average case analysis of an algorithm? [8]

OR

Q.1 (a) Why are asymptotic notations important? Explain the concept of Big-oh, theta & omega in brief. [8]

(b) Explain row major & column major form of array with suitable example. [8]

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UNIT-II

Q.2 (a) Explain transposition of sparse matrices with algorithms of varying complexity. [8]

(b) Write down an algorithm for insertion & deletion operation performed on the deque. [8]

OR

Q.2 (a) What do you mean by tower of Hanoi problem? Explain with suitable example. [8]

(b) Transform the following expression in Postfix Notation:

$A * (B + D) / E - F * (G + H / K)$ [8]

UNIT-III

Q.3 (a) Write an algorithm to delete a node from doubly linked list, where a node contains one data and two address (previous & next) portion. [8]

(b) How can a polynomial such as $5x^4 - 3x^2 + 9x - 11$ be represented by a linked list? [8]

OR

Q.3 (a) Explain the advantages of binary search over sequential search. [8]

(b) Discuss concepts of Head Node in linked lists in brief with suitable example. [8]

UNIT-IV

Q.4 (a) What is binary tree? Mention the properties of a binary tree. Define the following- [8]

(i) Strictly binary tree

(ii) Complete binary tree

(b) The in-order & pre-order traversal sequence of nodes in a binary tree are given below: [8]

In-order: E A C K F H D B G

Pre-order: F A E K C D H G B

Draw the binary tree. State briefly the logic used to construct the tree.

OR

Q.4 (a) Explain concept of balance factor in AVL tree with suitable example. [4]

(b) Insert the following keys in the order given below to build them into an AVL tree. [4]

g, h, s, l, e, m, t, u.

Mention different rotations used and balance factor of each node.

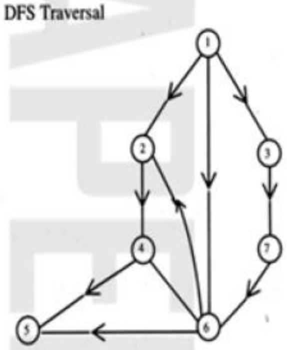
(c) Write an algorithm for inorder traversal of a threaded binary tree. [8]

UNIT-V

Q.5 (a) Find -

(i) BFS Traversal

(ii) DFS Traversal



For Given Graph. Explain in brief. [12]

RTU paper

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ASSIGNMENT1

Sub:DataStructuresandAlgorithms

PARTA (Writeshortanswerson following)

1. DatastructuresDefinition		BL-1	CO1
2. ComplexityDefinition		BL-1	CO1
3. AlgorithmDefinition		BL-1	CO1
4. DifferencebetweenstackandQueue	BL-4	CO2	
5. ApplicationsofQueue		BL-3	CO3
6. HeaderLinkedListDefinition		BL-1	CO3
7. DoublyLinkedList	BL-1	CO3	
8. PriorityQueue		BL-1	CO2
9. Dequeue		BL-1	CO2
10. Differencebetweenpeek()andpop()function		BL-4	CO2

PARTB

1. Writeanalgorithmtoinsertanddeleteanelementinstack usingarray.
2. Writedownalltheadvantagesanddisadvantages ofdoublylinkedlistoverlinearlinkedlist.
3. Writedown thedifferencesbetweenArrayandLinkedList.
4. Writethealgorithmsforthestaticimplementationof Queue.
5. ExplaintheTowerofHanoiproblem.

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PARTC (LongAnswers)

1. Writeanalgorithmtoconvertaninfixexpressionintopostfixexpression.Convertthefollowingexpressionintopostfix:-X=A+(B*C-(D/E-F)*G)*H.

2. Writean algorithmtoevaluatethepostfixexpression.Evaluatethefollowing expressionusingstack.X=4,5,4,2,^,+,*,2,2,^,9,3,/,*,-.
3. Writedownthealgorithmstoinsertanddeleteanelementattheendofcirculardoublylinkedlist.

4. Writeanalgorithmforallthecasestoinsertanelementinthelinearlinkedlist

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ASSIGNMENT2

Sub:Data StructuresandAlgorithms

PARTA(Writeshort answersonfollowing)

1. CompleteBinaryTree
2. StrictlyBinaryTree
3. ThreadedBinaryTree
4. AVLTree
5. M-waySearchTree
6. BTree
7. BinarySearching
8. QuickSort
9. PathMatrix
10. AdjencyList

PARTB

1. Sortthefollowinglistinincreasingorderusingbubblesorttechnique:L=<1,2,10,6,5,9,7 ,3,8,4>
2. ExplainthevariousapplicationsofGraph.
3. Explaintheadvantagesofbinarysearchover sequentialsearch.
4. ExplaintheconceptofbalancefactorinAVL treewithsuitableexample.
5. ExplainDijkstraalgorithm.

PARTC(LongAnswers)

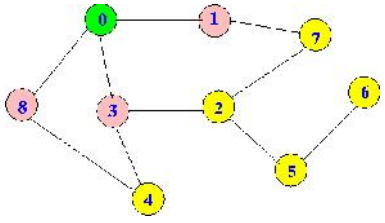
1. TheInorderandPreorder Traversalsequenceofnodesinabinarytreearegivenbelow:Inorder:EA CK FH D BG
   Preorder:F AE KCDH GB

Drawthebinarytree.Statebriefly thelogicused toconstructthetree.

2. CreateanAVL treeforthefollowing

   listofelements.L=<5,4,3,2,1,6,7,8,9,10>

3. WritePrimsalgorithm togetminimumspanning treeoutof agraph.
4. ConsidertheGraphgivenbelow.Findoutitsbreadth-firstsearchtraversalscheme.



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Mid Term Paper

Swami Keshvanand Institute of Technology, Management &Gramothan, Jaipur

I Mid Term Examination, Sept.-2022

Semester:	**III**	**Branch:**	**CSE/AI/DS/IT**
Subject:	**Data Structures and Algorithms**	**Subject Code:**	**3CS4-05/3CAI4-05/3AID4-05/3IT4-05**
Time:	**1.5 Hours**	**Maximum Marks:**	**20**
Session (I/II/III): II			

PART A (short-answer type questions)

(All questions are compulsory) **(3*2=6)**

Q.1What is Complexity of an Algorithm?

Q.2 Differentiate between Static and Dynamic Memory Allocation.

Q.3 Differentiate between Linear Queue and Circular Queue.

PART B (Analytical/Problem solving questions)

(Attempt any 2 Questions) **(2*4=8)**

Q.4 Write an algorithm for any two cases to insert an element in the linear linked list.
Q.5 Write an algorithm for insertion operation in circular queue using array.

Q.6 Explain Tower of Hanoi Problem for n=3 using recursion.

PART C (Descriptive/Analytical/Problem solving/Design questions)

(Attempt any 1 Question) **(1*6=6)**

Q.7 Convert the following arithmetic expression into postfix expression:

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

Q.8 Write an algorithm for deleting last node from doubly linked list.

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Question Paper Solution

Branch/Semester: III	**Subject: DSA**	**Subject Code: 3CS4-05/3CAI4-05/3AID4-05/3IT4-05**
Duration: 1.5 hours	**Date: 28.9.2022 Session (I/II/III): II**	**Max Marks:20**
Submitted By: PawanPatidar, RuchikaKhandelwal, Mani Butwal, NikharBhatnagar, Dr. NehaJanu, Rajesh Ranjan		

1. What is Complexity of an Algorithm?

Ans. Algorithmic complexity is a measure of how long an algorithm would take to complete given an input of size n. If an algorithm has to scale, it should compute the result within a finite and practical time bound even for large values of n. For this reason, complexity is calculated asymptotically as n approaches infinity.

Sometimes, there is more than one way to solve a problem. We need to learn how to compare the performance different algorithms and choose the best one to solve a particular problem. While analyzing an algorithm, we mostly consider time complexity and space complexity.

Time complexity of an algorithm quantifies the amount of time taken by an algorithm to run as a function of the length of the input. Similarly, Space complexity of an algorithm quantifies the amount of space or memory taken by an algorithm to run as a function of the length of the input.

Space Complexity: Space complexity is amount of space taken by an algorithm to complete the execution. Basically it is combination of two parts fixed part and variable part.
Time Complexity: Time complexity of an algorithm is a function fn that describes the running time requirement for that algorithm.

2. Differentiate between Static and Dynamic Memory Allocation.

Ans.

S.No.	Static Memory Allocation	Dynamic Memory Allocation
1	In the static memory allocation, variables get allocated permanently, till the program executes or function call finishes.	In the Dynamic memory allocation, variables get allocated only if your program unit gets active.
2	Static Memory Allocation is done before program execution.	Dynamic Memory Allocation is done during program execution.
3	It uses stack for managing the static allocation of memory	It uses heap for managing the dynamic allocation of memory
4	It is less efficient	It is more efficient
	In Static Memory Allocation, there is no	In Dynamic Memory Allocation, there is memory re-

6	In static memory allocation, once the memory is allocated, the memory size can not change.	In dynamic memory allocation, when memory is allocated the memory size can be changed.
7	In this memory allocation scheme, we cannot reuse the unused memory.	This allows reusing the memory. The user can allocate more memory when required. Also, the user can release the memory when the user needs it.
8	In this memory allocation scheme, execution is faster than dynamic memory allocation.	In this memory allocation scheme, execution is slower than static memory allocation.
9	In this memory is allocated at compile time.	In this memory is allocated at run time.
10	In this allocated memory remains from start to end of the program.	In this allocated memory can be released at any time during the program.
11	**Example:** This static memory allocation is generally used for array.	**Example:** This dynamic memory allocation is generally used for linked list.

3. Differentiate between Linear Queue and Circular Queue.
Ans.

S.no.	Linear Queue	Circular Queue
1.	Arranges the data in a linear pattern.	Arranges the data in a circular order where the rear end is connected with the front end.
2.	The insertion and deletion operations are fixed i.e, done at the rear and front end respectively.	Insertion and deletion are not fixed and it can be done in any position.
3.	Linear queue requires more memory space.	It requires less memory space.
4.	In the case of a linear queue, the element added in the first position is going to be deleted in the first position. The order of operations performed on any element is fixed i.e, FIFO.	In the case of circular queue, the order of operations performed on an element may change.
5.	It is inefficient in comparison to a circular queue.	It is more efficient in comparison to linear queue.

6.	In a linear queue, we can easily fetch out the peek value.	In a circular queue, we cannot fetch out the peek value easily.
7.	Application- People standing for the bus. Cars lined on a bridge.	Application- Computer-controlled traffic signal In CPU scheduling and memory management.
8.	If there are 10 spaces then in the best case all the 10 spaces in the queue can be filled	If there are 10 spaces then in the best case 9 spaces can be filled at a time

4. Write an algorithm for any two cases to insert an element in the linear linked list.
Ans.

INSERTION AT BEGINNING

Step 1: IF AVAIL = NULL
Write OVERFLOW
Go to Step 7
[END OF IF]
Step 2: SET NEW_NODE = AVAIL
Step 3: SET AVAIL = AVAIL → NEXT
Step 4: SET NEW_NODE → DATA = VAL
Step 5: SET NEW_NODE → NEXT = HEAD
Step 6: SET HEAD = NEW_NODE
Step 7: EXIT

INSERTION IN SINGLY LINKED LIST AT THE END

Step 1: IF AVAIL = NULL Write OVERFLOW
Go to Step 1
[END OF IF]
Step 2: SET NEW_NODE = AVAIL
Step 3: SET AVAIL = AVAIL - > NEXT
Step 4: SET NEW_NODE - > DATA = VAL
Step 5: SET NEW_NODE - > NEXT = NULL
Step 6: SET PTR = HEAD
Step 7: Repeat Step 8 while PTR - >NEXT != NULL
Step 8: SET PTR = PTR - >NEXT
[END OF LOOP]
Step 9: SET PTR - > NEXT = NEW_NODE
Step 10: EXIT

5. Write an algorithm for insertion operation in queue using array.

Ans:

Algorithm Insert in queue

1. **If** (REAR = size) **then** //Queue is full
2. Write "Queue is full"
3. **Exit**
4. **Else**

REAR = REAR + 1 // increment REAR

5. Que[REAR] = ITEM

6. If (FRONT = -1) **then** //Queue is empty

7. Set FRONT = 0

10. **End if**

Algorithm Delete in queue:

1. **If**(FRONT = -1) **then**
2. wwrite "Queue is empty"
3. **Exit**
4. **Else**
5. ITEM = Que [FRONT]
6. **If** (FRONT = REAR)
7. set REAR **= -1**
8. set FRONT = -1
9. **Else**
10. FRONT = FRONT **+** 1
11. **End if**

12. End if

13. Stop

6.Explain Tower of Hanoi Problem for n=3 using recursion.

It is a mathematical game or puzzle that consists of three rods with 'n' number of disks of different diameters.

The objective of the game is to shift the entire stack of disks from one rod to another rod following these three rules :

1. Only one disk can be moved at a time.
2. Only the uppermost disk from one stack can be moved on to the top of another stack or an empty rod.
3. Larger disks cannot be placed on the top of smaller disks.

The minimal number of moves required to solve the Tower of Hanoi puzzle of n disks would be (2^n) − 1.

The logic behind solving the Tower of Hanoi for three disks :

Objective: To solve the Tower of Hanoi puzzle that contains three disks. The stack of disks has to be shifted from Rod 1 to Rod 3 by abiding to the set of rules that has been mentioned above.

Step 1 : The smallest green disk , the uppermost disk on the stack is shifted from rod 1 to rod 3.

Step 2 : Next the uppermost disk on rod 1 is the blue colored disk which is shifted to rod 2.

Step 3 : The smallest disk placed on rod 3 is shifted back on to the top of rod 2.

Step 4 : So now the largest red disk is allowed to be shifted from rod 1 to its destination rod 3.

Step 5 : Now the two disks on rod 2 has to be shifted to its destination rod 3 on top of the red disk , so first the smallest green disk on top of the blue rod is shifted to rod 1 .

Step 6 : Next the blue disk is permitted to be shifted to its destination rod 3 that will stacked on to the top of the red disk.

Step 7 : Finally , the smallest green colored rod is also shifted to rod 3 , which would now be the uppermost rod on the stack .

So the Tower of Hanoi for three disks has been solved!!

Algorithm

To write an algorithm for Tower of Hanoi, first we need to learn how to solve this problem with lesser amount of disks, say → 1 or 2. We mark three towers with name, source, destination and aux (only to help moving the disks). If we have only one disk, then it can easily be moved from source to destination peg.

If we have 2 disks −

- First, we move the smaller (top) disk to aux peg.
- Then, we move the larger (bottom) disk to destination peg.
- And finally, we move the smaller disk from aux to destination peg.

The steps to follow are −

Step 1 − Move n-1 disks from source to aux

Step 2 − Move n^{th} disk from source to dest

Step 3 − Move n-1 disks from aux to dest

A recursive algorithm for Tower of Hanoi can be driven as follows −

START

Procedure Hanoi(disk, source, dest, aux)

IF disk == 1, THEN

move disk from source to dest

ELSE

Hanoi(disk - 1, source, aux, dest) // Step 1

move disk from source to dest // Step 2

Hanoi(disk - 1, aux, dest, source) // Step 3

END IF

END Procedure

STOP

7. Convert the following arithmetic expression into postfix expression:

X=A+ (B*C-(D/E-F)*G)*H.

Ans: X=A+ (B*C-(D/E-F)*G)*H

Symbol	Scanned	STACK	Postfix Expression	Description
1.		(		Start
2.	A	(	A	
3.	+	(+	A	
4.	(	(+(	A	
5.	B	(+(	AB	
6.	*	(+(*	AB	
7.	C	(+(*	ABC	
8.	-	(+(-	ABC*	'*' is at higher precedence than '-'
9.	(	(+(-(	ABC*	
10.	D	(+(-(	ABC*D	
11.	/	(+(-(/	ABC*D	
12.	E	(+(-(/	ABC*DE	
13.	^	(+(-(/^	ABC*DE	
14.	F	(+(-(/^	ABC*DEF	
15.	)	(+(-	ABC*DEF^/	Pop from top on Stack , that's why '^' Come first
16.	*	(+(-*	ABC*DEF^/	
17.	G	(+(-*	ABC*DEF^/G	
18.	)	(+	ABC*DEF^/G*-	Pop from top on Stack , that's why '^' Come first
19.	*	(+*	ABC*DEF^/G*-	
20.	H	(+*	ABC*DEF^/G*-H	
21.	)	Empty	ABC*DEF^/G*-H*+	END

8 Write an algorithm for deleting last node from doubly linked list.

Ans.

- **STEP 1 :** NOW IF HEAD = NULL (GO TO STEP 6)
- **STEP 2 :** ASSIGN EXTRA = HEAD
- **STEP 3 :** MAKE A LOOP WHILE EXTRA = NEXT != NULL
- **STEP 4 :** ASSIGN EXTRA = EXTRA -> NEXT (END THE WHILE LOOP)
- **STEP 5 :** THAN ASSIGN EXTRA -> PREVIOUS -> NEXT = NULL
- **STEP 6 :** THAN FREE EXTRA
- **STEP 7 :** EXIT

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Analysis of Question Paper

I Mid-Term Examination, Sept.- 2022

Branch/Semester: III	**Subject: Data Structures and Algorithm**	**Subject Code: 3CS4-05/3CAI4-05/3AID4-05/3IT4-05**
Duration: 1.5 hours	**Session (I/II/III): II**	**Max Marks:20**
Submitted By:	**PawanPatidar, RuchikaKhandelwal, NehaJanu, Mani Butwall, NikharBhatnagar, Pratipal Singh, Rajesh Ranjan**	

A. Distribution of Course Outcome and Bloom's Taxonomy in Question Paper

Q.No	Questions	Marks	CO	BL
1	**What is Complexity of an Algorithm?**	2	CO3	BL1
2	**Differentiate between Static and Dynamic Memory Allocation.**	2	CO3	BL2
3	**Differentiate between Linear Queue and Circular Queue.**	2	CO2	BL2
4	**Write an algorithm for any two cases to insert an element in the linear linked list.**	4	CO2	BL1
5	**Write an algorithm for insertion operation in circular queue using array**	4	CO1	BL1
6	**Explain Tower of Hanoi Problem for n=3 using recursion.**	4	CO1	BL2
7	**Convert the following arithmetic expression into postfix expression:** **A + (B * C - (D / E ^ F) * G) * H**	6	CO1	BL5
8	**Write an algorithm for deleting last node from doubly linked list.**	6	CO2	BL1

BL – Bloom's Taxonomy Level

(1- Remembering, 2- Understanding, 3 – Applying, 4 – Analyzing, 5 – Evaluating, 6 - Creating)

CO – Course Outcome

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B.Questions and Course Outcomes (COs) Mapping in terms of correlation

COs	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
CO1					3	3	3	
CO2			3	3				3
CO3	2	2						
CO4								
CO5								

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

C. Mapping of Bloom's Level and Course Outcomes with Question Paper

Bloom's Level Mapping		CO Mapping	
Bloom's Level	Percentage	CO	Percentage
BL1	53.33%	CO1	46.66%
BL2	26.66%	CO2	40%
BL3		CO3	13.33%
BL4		CO4	
BL5	20%	CO5	
BL6		CO6	

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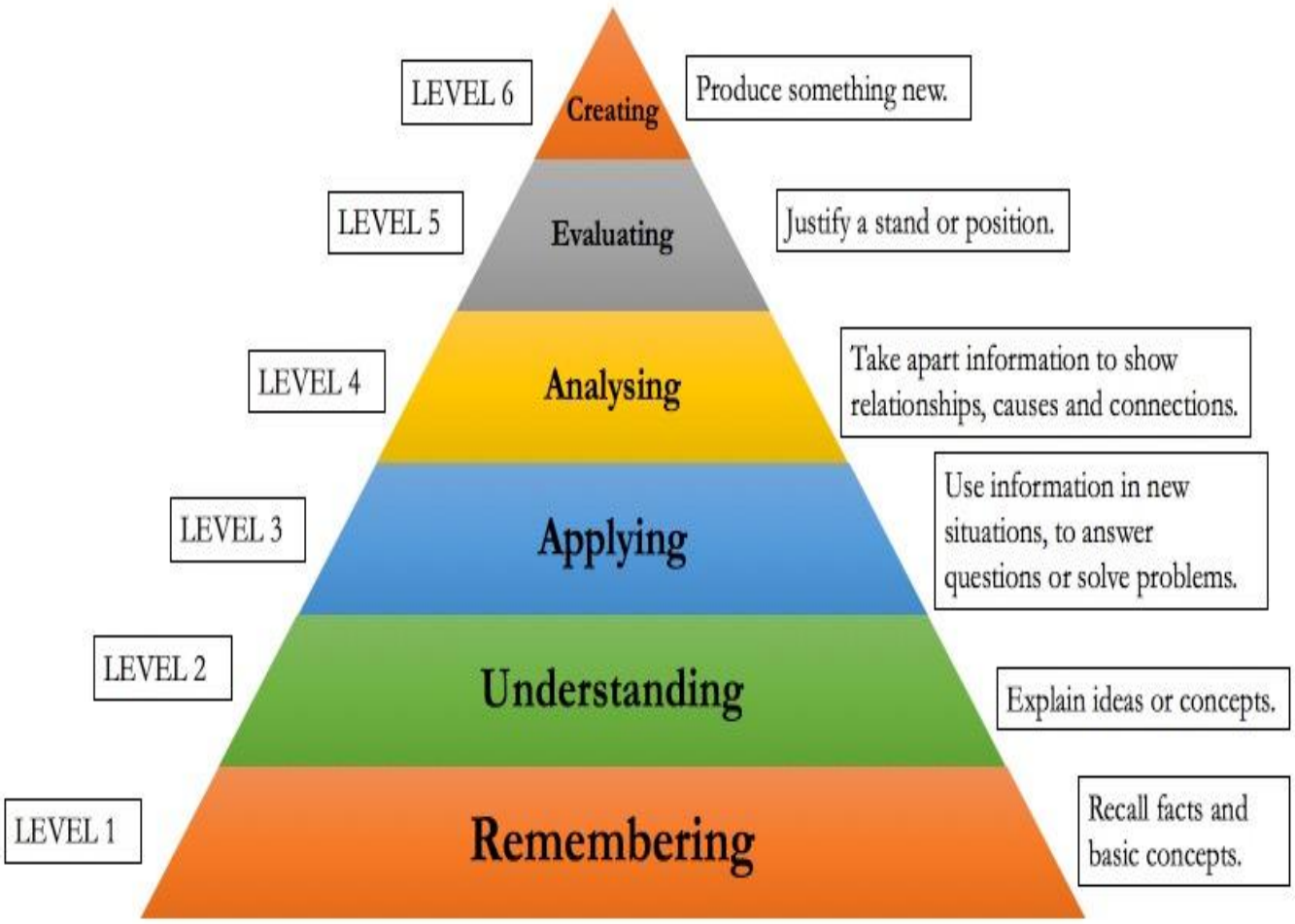
Bloom taxanomy



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Mid Term Paper

Swami Keshvanand Institute of Technology, Management &Gramothan, Jaipur

II Mid Term Examination, Sept.-2022

Semester:	**III**	**Branch:**	**CSE/AI/DS/IT**
Subject:	**Data Structures and Algorithms**	**Subject Code:**	**3CS4-05/3CAI4-05/3AID4-05/3IT4-05**
Time:	**1.5 Hours**	**Maximum Marks:**	**20**
Session (I/II/III): II			

PART A (short-answer type questions)

(All questions are compulsory) (3*2=6)

Q1.Define Complete Binary Tree?

Q2. Differentiate between Linear Search and Binary Search.

Q3. Explain the concept of Minimum Spanning Tree?.

PART B (Analytical/Problem solving questions)

(Attempt any 2 Questions) (2*4=8)

Q4.Write an algorithm for Quick Sort with example.
Q5.What do you understand by Binary Search Tree? Construct a binary search tree where input list is:
J, R, D, G, T, E, M, H, P, A, F, Q
Q6.The In-order & Pre-order traversal sequence of nodes in binary tree are given below:
In-order: E X M B S A P T N W H C
Pre-Order: A B X E M S W T P N C H
Draw the binary tree and Write down the algorithm for both the Traversals.

PART C (Descriptive/Analytical/Problem solving/Design questions)

(Attempt any 1 Question) (1*6=6)

Q.7 Explain AVL Tree? Insert the following list of element in an AVL tree: 21, 26, 30, 9, 4, 14, 28, 18, 15

Q8.Briefly discuss Graph? Write an Algorithm for DFS with example.

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Question Paper Solution

Branch/Semester: III	**Subject: DSA**	**Subject Code: 3CS4-05/3CAI4-05/3AID4-05/3IT4-05**
Duration: 1.5 hours	**Date: 21.12.2022 Session (I/II/III): II**	**Max Marks:20**
Submitted By: PawanPatidar, RuchikaKhandelwal, Mani Butwal, NikharBhatnagar, Dr. NehaJanu, Rajesh Rajaan		

PART-A

1. Define Complete Binary Tree?

Ans. A complete binary tree is a special type of binary tree where all the levels of the tree are filled completely except the lowest level nodes which are filled from as left as possible.

- A complete binary tree is said to be a proper binary tree where all leaves have the same depth.
- In a complete binary tree number of nodes at depth d is 2d.
- In a complete binary tree with n nodes height of the tree is log(n+1).
- All the levels except the last level are completely full.

2. Differentiatebetween Linear Search and Binary Search.

Ans.

Basis of comparison	Linear search	Binary search
Definition	The linear search starts searching from the first element and compares each element with a searched element till the element is not found.	It finds the position of the searched element by finding the middle element of the array.
Sorted data	In a linear search, the elements don't need to be arranged in sorted order.	The pre-condition for the binary search is that the elements must be arranged in a sorted order.
Implementation	The linear search can be implemented on any linear data structure such as an array, linked list, etc.	The implementation of binary search is limited as it can be implemented only on those data structures that have two-way traversal.
Approach	It is based on the sequential approach.	It is based on the divide and conquer approach.
Size	It is preferrable for the small-sized data sets	It is preferrable for the large-size data

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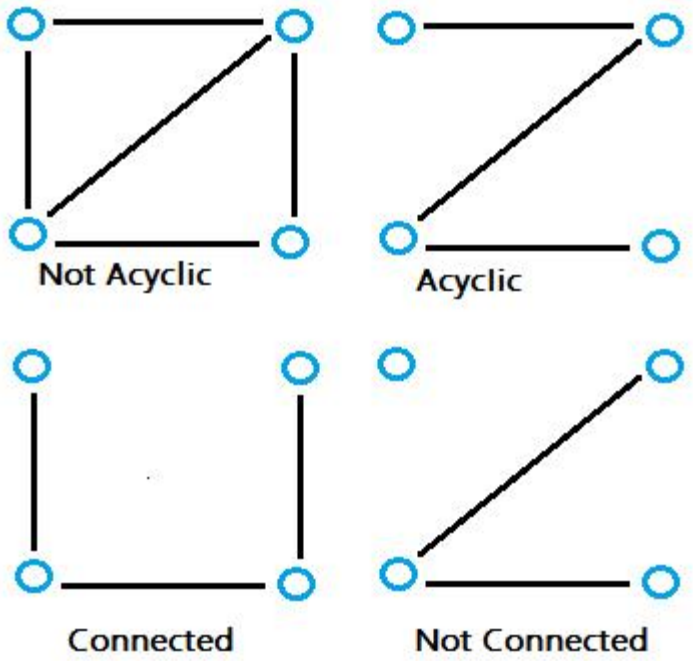
Submitted By: PawanPatidar, RuchikaKhandelwal, Mani Butwal, NikharBhatnagar, Dr. NehaJanu, Rajesh Rajaan		

3. Explain the concept of Minimum Spanning Tree?

Ans. A minimum spanning tree is a special kind of tree that minimizes the lengths (or "weights") of the edges of the tree. An example is a cable company wanting to lay line to multiple neighborhoods; by minimizing the amount of cable laid, the cable company will save money.

A tree has one path joins any two vertices. A spanning tree of a graph is a tree that:

- Contains all the original graph's vertices.
- Reaches out to (spans) all vertices.
- Is acyclic. In other words, the graph doesn't have any nodes which loop back to itself.



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PART-B

4. Write an algorithm for Quick Sort with example.

Ans.

QUICKSORT (array A, start, end)

{

1 if (start < end)

2 {

3 p = partition(A, start, end)

4 QUICKSORT (A, start, p - 1)

5 QUICKSORT (A, p + 1, end)

6 }

}

Partition Algorithm:

The partition algorithm rearranges the sub-arrays in a place.

PARTITION (array A, start, end)

{

1 pivot = A[end]

2 i = start-1

3 for j = start to end -1 {

4 do if (A[j] < pivot) {

5 then i = i + 1

6 swap A[i] with A[j]

7 }}

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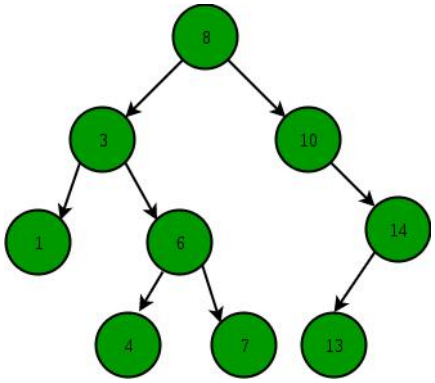
5. What do you understand by Binary Search Tree? Construct a binary search tree where input list is:
J, R, D, G, T, E, M, H, P, A, F, Q

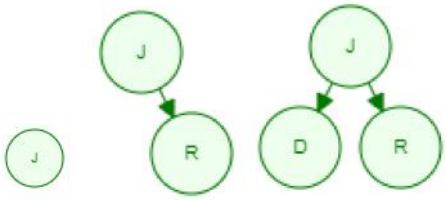
Ans. Binary Search Tree is a node-based binary tree data structure which has the following properties:

- The left subtree of a node contains only nodes with keys lesser than the node's key.
- The right subtree of a node contains only nodes with keys greater than the node's key.
- The left and right subtree each must also be a binary search tree.



Construct a binary search tree where input list is:
J, R, D, G, T, E, M, H, P, A, F, Q

Insert J Insert R Insert D



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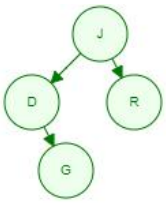
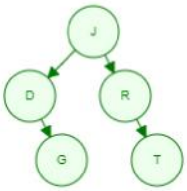
Insert G





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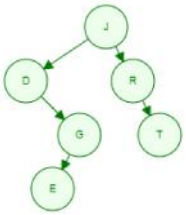

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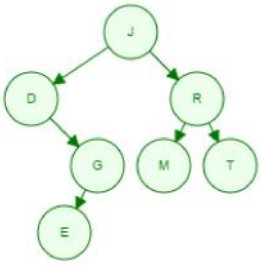
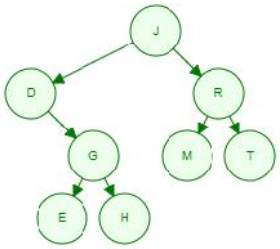


Insert M

Insert H



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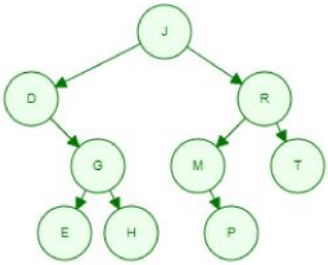
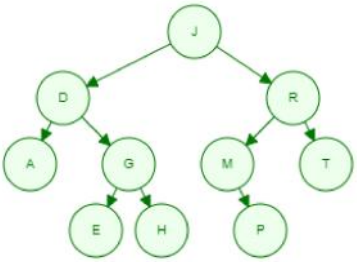
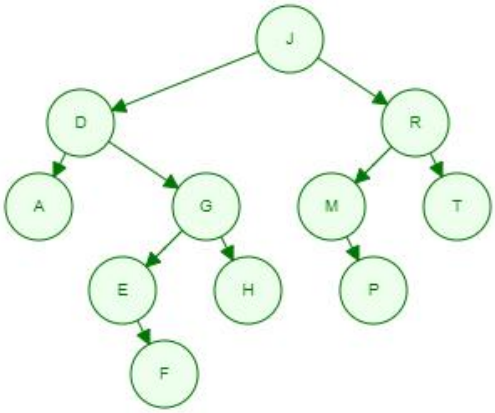


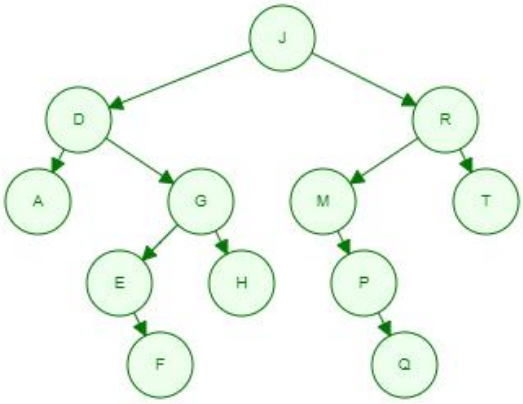
Insert A



Insert F



Insert Q



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6. The In-order & Pre-order traversal sequence of nodes in binary tree are given below:
In-order: E X M B S A P T N W H C
Pre-Order: A B X E M S W T P N C H
Draw the binary tree.

Answer.

Algorithms

InOrder (T)

If T <> null

print ('empty tree')

If T.lp<> null

thenInOrder(T.lp)

print (T.data)

If T.rp<> null

thenInOrder (T.lp)

end.

PreOrder (T)

If T <> Null

then print (T.data)

else print('empty tree')

If T.lp<> null

thenPreOrder(T.lp)

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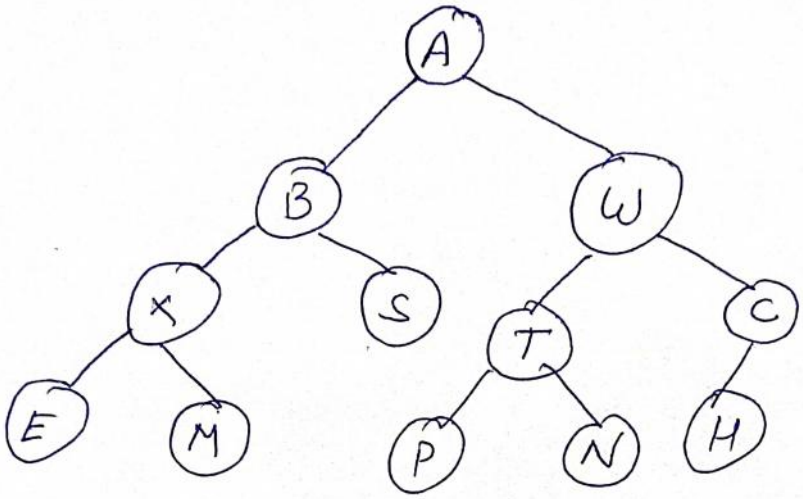
Inorder :- E X M B S A P T N W H C

Pre-order :- A B X E M S W T P N C H



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PART-C

7. Explain AVL Tree? Insert the following list of element in an AVL tree: 10, 20, 30, 35, 25, 5, 40, 45, 34

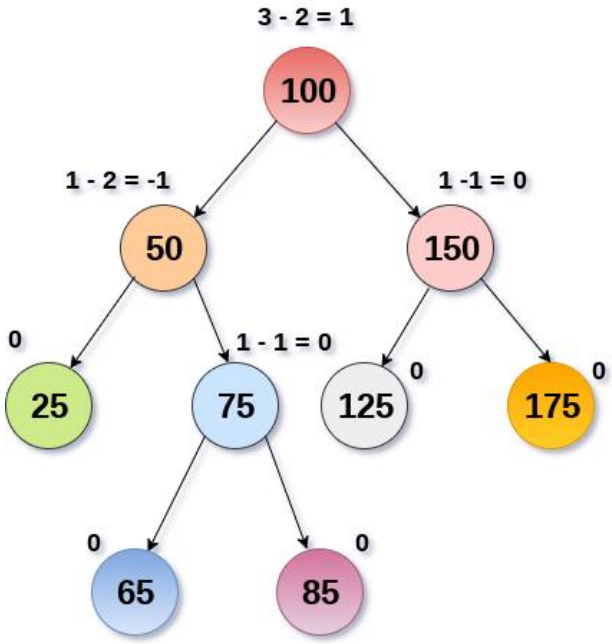
Ans.

AVL tree is a self-balancing Binary Search Tree (BST) where the difference between heights of left and right subtrees cannot be more than one for all nodes.

AVL Tree can be defined as height balanced binary search tree in which each node is associated with a balance factor which is calculated by subtracting the height of its right sub-tree from that of its left sub-tree.

Tree is said to be balanced if balance factor of each node is in between -1 to 1, otherwise, the tree will be unbalanced and need to be balanced.

Balance Factor (k) = height (left(k)) - height (right(k))



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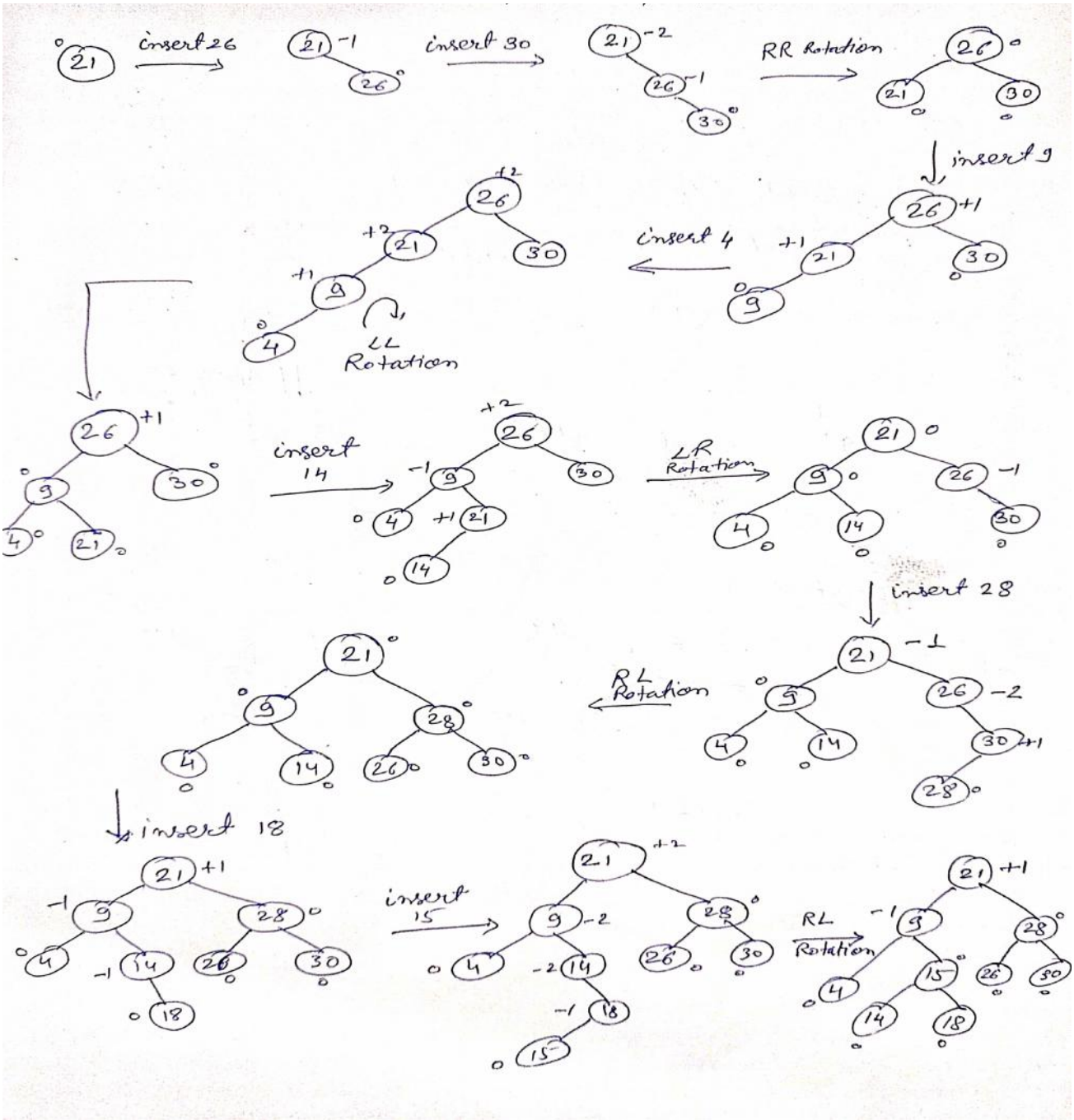
Submitted By: PawanPatidar, RuchikaKhandelwal, Mani Butwal, NikharBhatnagar, Dr. NehaJanu, Rajesh Rajaan

AVL Tree Creation: - 21, 26, 30, 9, 4, 14, 28, 18, 15



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Question Paper Solution

Branch/Semester: III	**Subject: DSA**	**Subject Code: 3CS4-05/3CAI4-05/3AID4-05/3IT4-05**
Duration: 1.5 hours	**Date: 21.12.2022 Session (I/II/III): II**	**Max Marks:20**
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8. Briefly discuss Graph? Write an Algorithm for DFS with example.

Ans. A graph can be defined as group of vertices and edges that are used to connect these vertices. A graph can be seen as a cyclic tree, where the vertices (Nodes) maintain any complex relationship among them instead of having parent child relationship.
A graph G can be defined as an ordered set G(V, E) where V(G) represents the set of vertices and E(G) represents the set of edges which are used to connect these vertices.

Step 1: SET STATUS = 1 (ready state) for each node in G

Step 2: Push the starting node A on the stack and set its STATUS = 2 (waiting state)

Step 3: Repeat Steps 4 and 5 until STACK is empty

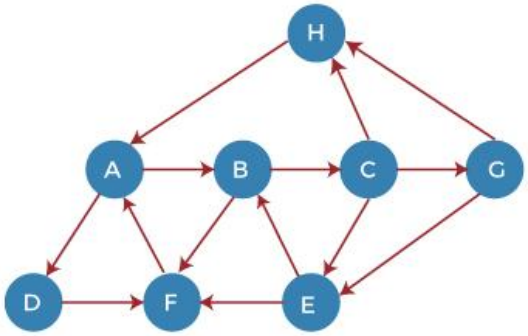
Step 4: Pop the top node N. Process it and set its STATUS = 3 (processed state)

Step 5: Push on the stack all the neighbors of N that are in the ready state (whose STATUS = 1) and set their STATUS = 2 (waiting state)

[END OF LOOP]

Step 6: EXIT

Example:-



Adjacency Lists

A : B, D
B : C, F
C : E, G, H
G : E, H
E : B, F
F : A
D : F
H : A

Question Paper Solution

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Now, let'sstart examining the graph starting from Node H.

Step 1 - First, push H onto the stack.

STACK: H

Step 2 - POP the top element from the stack, i.e., H, and print it. Now, PUSH all the neighbors of H onto the stack that are in ready state.

Print: H STACK: A

Step 3 - POP the top element from the stack, i.e., A, and print it. Now, PUSH all the neighbors of A onto the stack that are in ready state.

. **Print: A STACK: B, D**

Step 4 -POP the top element from the stack, i.e., D, and print it. Now, PUSH all the neighbors of D onto the stack that are in ready state.

. **Print: D STACK: B, F**

Step 5 -POP the top element from the stack, i.e., F, and print it. Now, PUSH all the neighbors of F onto the stack that are in ready state.

. **Print: F STACK: B**

Step 6 - POP the top element from the stack, i.e., B, and print it. Now, PUSH all the neighbors of B onto the stack that are in ready state.

. **Print: B STACK: C**

Step 7 - POP the top element from the stack, i.e., C, and print it. Now, PUSH all the neighbors of C onto the stack that are in ready state.

. **Print: C STACK: E, G**

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Step 8 -POP the top element from the stack, i.e., G and PUSH all the neighbors of G onto the stack that are in ready state.

. **Print: G STACK: E**

Step 9 -POP the top element from the stack, i.e., E and PUSH all the neighbors of E onto the stack that are in ready state.

. **Print: E STACK:**

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A. Distribution of Course Outcome and Bloom's Taxonomy in Question Paper

Q.No	Questions	Marks	CO	BL
1	Define Complete Binary Tree?	2	CO4	BL2
2	Differentiate between Linear Search and Binary Search.	2	CO3	BL2
3	Explain the concept of Minimum Spanning Tree?	2	CO5	BL2
4	Write an algorithm for Quick Sort with example.	4	CO3	BL3
5	What do you understand by Binary Search Tree? Construct a binary search tree where input list is: J, R, D, G, T, E, M, H, P, A, F, Q	4	CO4	BL6
6	The In-order & Pre-order traversal sequence of nodes in binary tree are given below: In-order: E X M B S A P T N W H C Pre-Order: A B X E M S W T P N C H Draw the binary tree and Write down the algorithm for both the Traversals.	4	CO4	BL6
7	Explain AVL Tree? Insert the following list of element in an AVL tree: 21, 26, 30, 9, 4, 14, 28, 18, 15	6	CO4	BL5
8	Briefly discuss Graph? Write an Algorithm for DFS with example.	6	CO5	BL3

BL – Bloom's Taxonomy Level

(1- Remembering, 2- Understanding, 3 – Applying, 4 – Analyzing, 5 – Evaluating, 6 - Creating)

CO – Course Outcome

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B.Questions and Course Outcomes (COs) Mapping in terms of correlation

COs	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
CO1								
CO2								
CO3		3		3				
CO4	3				3	3	3	
CO5			3					3

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

C. Mapping of Bloom's Level and Course Outcomes with Question Paper

Bloom's Level Mapping		**CO Mapping**	
Bloom's Level	Percentage	CO	Percentage
BL1		CO1	
BL2	20%	CO2	
BL3	33.33%	CO3	20%
BL4		CO4	53.33%
BL5	20%	CO5	26.66%
BL6	26.66%	CO6	

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Technical Quiz Paper

1. Which of these best describes an array?
   a) A data structure that shows a hierarchical behavior
   b) Container of objects of similar types
   c) Arrays are immutable once initialized
   d) Array is not a data structure

Answer:- b

2. How do you initialize an array in C?
   a) intarr[3] = (1,2,3);
   b) intarr(3) = {1,2,3};
   c) intarr[3] = {1,2,3};
   d) intarr(3) = (1,2,3);

Answer:- c

3. Which of the following is the correct way to declare a multidimensional array in Java?
   a) int[] arr;
   b) intarr[[]];
   c) int[][]arr;
   d) int[[]] arr;

Answer:- c

4. Which of the following concepts make extensive use of arrays?
   a) Binary trees
   b) Scheduling of processes
   c) Caching
   d) Spatial locality

Answer:- d

5. Assuming int is of 4bytes, what is the size of intarr[15];?
a) 15
b) 19
c) 11
d) 60

Answer:- d

6. What does 'stack underflow' refer to?
a) accessing item from an undefined stack
b) adding items to a full stack
c) removing items from an empty stack
d) index out of bounds exception

Answer:- c

7. What is the time complexity of pop() operation when the stack is implemented using an array?
a) O(1)
b) O(n)
c) O(logn)
d) O(nlogn)

Answer:- a

8. Array implementation of Stack is not dynamic, which of the following statements supports this argument?
a) space allocation for array is fixed and cannot be changed during run-time
b) user unable to give the input for stack operations
c) a runtime exception halts execution
d) improper program compilation

Answer:- a

10 .Which of the following statements are not correct with respect to Singly Linked List(SLL) and Doubly Linked List(DLL)?
a) Complexity of Insertion and Deletion at known position is O(n) in SLL and O(1) in DLL
b) SLL uses lesser memory per node than DLL
c) DLL has more searching power than SLL
d) Number of node fields in SLL is more than DLL

Answer:- d

11. Which of the following data structures can be used for parentheses matching?
a) n-ary tree
b) queue
c) priority queue
d) stack

Answer:- d

12. Minimum number of queues to implement stack is _____
a) 3
b) 4
c) 1
d) 2

Answer:- c

13. In linked list implementation of a queue, front and rear pointers are tracked. Which of these pointers will change during an insertion into a NONEMPTY queue?
a) Only front pointer
b) Only rear pointer
c) Both front and rear pointer
d) No pointer will be changed

Answer:- b

14. In case of insertion into a linked queue, a node borrowed from the _____ list is inserted in the queue.
a) AVAIL
b) FRONT
c) REAR
d) NULL

Answer:- a

15. In linked list implementation of a queue, from where is the item deleted?
a) At the head of link list
b) At the centre position in the link list
c) At the tail of the link list
d) Node before the tail

Answer: -a

16. How many children does a binary tree have?
a) 2
b) any number of children
c) 0 or 1 or 2
d) 0 or 1

Answer:- c

17. Consider a situation of writing a binary tree into a file with memory storage efficiency in mind, is array representation of tree is good?
a) yes because we are overcoming the need of pointers and so space efficiency
b) yes because array values are indexable
c) No it is not efficient in case of sparse trees and remaning cases it is fine
d) No linked list representation of tree is only fine

Answer:- c

18. Can a tree stored in an array using either one of inorder or post order or pre order traversals be again reformed?
a) Yes just traverse through the array and form the tree
b) No we need one more traversal to form a tree
c) No in case of sparse trees
d) Yes by using both inorder and array elements

Answer:- b

19. Which of the following is false about a binary search tree?
a) The left child is always lesser than its parent
b) The right child is always greater than its parent
c) The left and right sub-trees should also be binary search trees
d) In order sequence gives decreasing order of elements

Answer:-d

20. What is the speciality about the inorder traversal of a binary search tree?
a) It traverses in a non increasing order
b) It traverses in an increasing order
c) It traverses in a random fashion
d) It traverses based on priority of the node

Answer:- b

21. What are the worst case and average case complexities of a binary search tree?
a) O(n), O(n)
b) O(logn), O(logn)
c) O(logn), O(n)
d) O(n), O(logn)

Answer:- d

22. What are the conditions for an optimal binary search tree and what is its advantage?
a) The tree should not be modified and you should know how often the keys are accessed, it improves the lookup cost
b) You should know the frequency of access of the keys, improves the lookup time
c) The tree can be modified and you should know the number of elements in the tree beforehand, it improves the deletion time
d) The tree should be just modified and improves the lookup time

Answer:- a

23. Which of the following statements for a simple graph is correct?
a) Every path is a trail
b) Every trail is a path
c) Every trail is a path as well as every path is a trail
d) Path and trail have no relation

Answer:- a

24. What is the number of edges present in a complete graph having n vertices?
a) (n*(n+1))/2
b) (n*(n-1))/2
c) n
d) Information given is insufficient

Answer: - b

25. A connected planar graph having 6 vertices, 7 edges contains _____ regions.
a) 15
b) 3
c) 1
d) 11

Answer:-b

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