DESIGN AND ANALYSIS OF ALGORITHMS

Subject Code: CS501PC
Regulations: R16 - JNTUH
Class: III Year B.Tech CSE I Semester

Department of Computer Science and Engineering

BHARAT INSTITUTE OF ENGINEERING AND TECHNOLOGY

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DESIGN AND ANALYSIS OF ALGORITHMS (CS501PC)
COURSE PLANNER

I. COURSE OVERVIEW:

Introduction to fundamental techniques for designing and analyzing algorithms, including asymptotic analysis; divide-and-conquer algorithms and disjoint set operations; graph algorithms; backtracking algorithms; greedy algorithms; dynamic programming; and branch and bound algorithms; NP-Hard and NP-Complete **problems**;

II. PREREQUISITE(S):

1. Problem Solving Skills
2. Basic Programming
3. Data Structures
4. Formal Languages and Automata Theory

III. COURSE OBJECTIVES:

1	To analyze performance of algorithms.
2	To choose the appropriate data structure and algorithm design method for a specified application.
3	To understand how the choice of data structures and algorithm design methods impacts the performance of programs.
4	To solve problems using algorithm design methods such as the greedy method, divide and conquer, dynamic programming, backtracking and branch and bound.
5	To understand the differences between tractable and intractable problems.
6	To introduce P and NP classes.

IV. COURSE OUTCOMES:

S.No	Description	Bloom's Taxonomy Level
1	Ability to **analyze** the performance of algorithms.	Analyze (level 4)
2	Ability to **choose** appropriate algorithm design techniques for **solving** problems.	Knowledge, Application (level 1, level 3)
3	Ability to **understand** how the choice of data structures and the algorithm **design** methods impact the performance of programs.	Understanding, Synthesis (Level 2, level 5)

V. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (PO)		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems related to Computer Science and Engineering.	**3**	Assignments
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems related to Computer Science and Engineering and reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	**3**	Assignments
PO3	**Design/development of solutions**: Design solutions for complex engineering problems related to Computer Science and Engineering and design system components or processes that meet the specified needs with appropriate consideration for the public health and	**2**	Assignments

	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.	**2**	Assignments
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 Computer Science and Engineering professional engineering practice.	**1**	Assignments
PO7	**Environment and sustainability**: Understand the impact of the Computer Science and Engineering 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 team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in ultidisciplinary 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.	**2**	Research

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)** **- : None**

VI. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

	Program Specific Outcomes (PSO)	Level	Proficiency assessed by
PSO1	**Foundation of mathematical concepts:** To use mathematical methodologies to crack problem using suitable mathematical analysis, data structure and suitable algorithm.	**3**	Lectures, Assignments
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.	**2**	Lectures, Assignments
PSO3	**Foundations of Software 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.	--	--

VII. SYLLABUS:

UNIT- I

Introduction-Algorithm definition, Algorithm Specification, Performance Analysis-Space complexity, Time complexity, Randomized Algorithms. **Divide and conquer**- General method, applications - Binary search, Merge sort, Quick sort, Strassen's Matrix Multiplication.

UNIT- II

Disjoint set operations, union and find algorithms, AND/OR graphs, Connected Components and Spanning trees, Bi-connected components **Backtracking**-General method, applications-The 8-queen problem, sum of subsets problem, graph coloring, Hamiltonian cycles.

UNIT-III

Greedy method- General method, applications- Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees, Single source shortest path problem.

UNIT- IV

Dynamic Programming- General Method, applications- Chained matrix multiplication, All pairs shortest path problem, Optimal binary search trees, 0/1 knapsack problem, Reliability design, Traveling sales person problem.

UNIT- V

Branch and Bound- General Method, applications-0/1 Knapsack problem, LC Branch and Bound solution, FIFO Branch and Bound solution, Traveling sales person problem.

NP-Hard and NP-Complete problems- Basic concepts, Non-deterministic algorithms, NP - Hard and NP- Complete classes, Cook's theorem.

SUGGESTED BOOKS:

TEXT BOOKS:

1. Fundamentals of Computer Algorithms, 2nd Edition, Ellis Horowitz, Sartaj Sahni and S. Rajasekharan, Universities Press.
2. Design and Analysis of Algorithms, P. H. Dave, H.B.Dave,2nd edition, Pearson Education.

REFERENCE BOOKS:

1. Algorithm Design: Foundations, Analysis and Internet examples, M. T. Goodrich and R. Tomassia, John Wiley and sons.
2. Design and Analysis of Algorithms, S. Sridhar, Oxford Univ. Press
3. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson Education.

4. Foundations of Algorithms,, R. Neapolitan and K. Naimipour, 4th edition, Jones an Bartlett Student edition.
5. Introduction to Algorithms,3rd Edition, T. H. Cormen, C. E.Leiserson, R. L. Rivest, and C. Stein, PHI

NPTEL Web Course:

1. http://nptel.ac.in/courses/106101060/
2. tps://onlinecourses.nptel.ac.in/noc16_cs04/preview

NPTEL Video Course:

1. http://www.nptelvideos.in/2012/11/design-analysis-of-algorithms.html

GATE SYLLABUS:

Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph search, minimum spanning trees, and shortest paths.

IES SYLLABUS:

Not Applicable

VIII. COURSE PLAN:

Sl No	Week	Topic	Course Learning outcomes	Reference
		UNIT-I		
1	**1**	**Introduction-**	**Understand** the fundamentals of Design and Analysis of Algorithms	**1**
2		Algorithm definition,		
3		Algorithm Specification,		
4		Performance Analysis-	**Compare** the performance of the algorithms	
5	**2**	Space complexity, Time complexity,		
6		Randomized Algorithms.		
7		**Divide and conquer**- General method,	**Describe** the Significance of Divide and Conquer Design method	
8		applications - Binary search,	**Apply** the Concept of Divide and Conquer method to solve the real world problems.	
9	**3**	Merge sort,		
10		Quick sort,		
11		Strassen's Matrix Multiplication		
12		BRIDGE CLASS -1	**Assess** the student skills.	
		UNIT-II		
13	**4**	Disjoint set operations,	**Explain** the basics of various mathematical concept of searching and	**1**
14		union and find algorithms,		
15		AND/OR graphs,		
16		Connected Components		

			traversing techniques.	
17	**5**	and Spanning trees,	**Understand** the various searching techniques.	
18		Bi-connected components	**Discuss** the various connected components techniques.	
19		**Backtracking**-General method,	**Define** the concept of Backtracking.	
20		Applications-The 8-queen problem,	**Compute** the real world problems by using Backtracking	
21	**6**	sum of subsets problem,		
22		graph coloring,		
23		Hamiltonian cycles		
24		BRIDGE CLASS -2	**Assess** the student skills.	
UNIT-III				
25	**7**	**Greedy method**- General method,	**Describe** the concept of Greedy method.	
26		applications- Knapsack problem,	**Apply** the Concept of Greedy method to solve the real world problems.	
27				
28		Job sequencing with deadlines,		
29	**8**			
30		Mock Test-1		**1**
		1st MID EXAMS		
31		Minimum cost spanning trees,	**Apply** the Concept of Greedy method to solve the real world problems.	
32				
33	**9**			
34		Single source shortest path problem.		
35				
36		BRIDGE CLASS-3	**Assess** the student skills.	
UNIT-IV				
37	**10**	**Dynamic Programming**- General Method, applications- Chained matrix multiplication,	**Understand** the Dynamic Programming techniques.	
38		All pairs shortest path problem,	**Demonstrate** the Dynamic programming techniques.	**1**
39		Optimal binary search trees,		
40		0/1 knapsack problem,		
41	**11**			
42		Reliabil0ity design,		
43				
44		Traveling sales person problem.		

UNIT-V				
45	**12**	**Branch and Bound-** General Method,	**State** the purpose of Branch and Bound	**1**
46		applications-0/1 Knapsack problem,	**Solve** the real world problems by using Branch and Bound.	
47		LC Branch and Bound solution, FIFO Branch and Bound solution,		
48		Traveling sales person problem.		
49	**13**	**NP-Hard and NP-Complete problems**- Basic concepts,	**Distinguish** the concept of NP-Hard and NP-Complete Problems.	
50		Non-deterministic algorithms,	**Discuss** the concept of Non-deterministic algorithms	
51		NP - Hard and NP- Complete classes, Cook's theorem	**Distinguish** the concept of NP-Hard and NP-Complete Problems.	
52		**BRIDGE CLASS-4**	**Assess** the student skills.	
53	**14**	**REVISION**	**Revise** the concepts of all units	
54				
55		**PREVIOUS PAPER DISCUSSION**	**Discuss** the questions from previous year question papers	
56				

IX. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

COs / POs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	-
CO2	3	3	2	3	-	-	-	-	-	-	-	-	2	3	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	1	1	-

X. QUESTION BANK: (JNTUH)

No	Question	Blooms Taxon	Program Outc

		omy Level	ome
UNIT – I			
PART – A (SHORT ANSWER QUESTIONS)			
1	**Define** the term algorithm and state the criteria the algorithm should satisfy.	Knowledge	1
2	**Compute** the average case time complexity of quick sort	Apply	7
3	**Describe** the role of space complexity and time complexity of a program?	Knowledge	1
4	If $f(n)=5n^2 + 6n + 4$, then **prove** that f(n) is $O(n^2)$	Apply	3
5	**What** is meant by divide and conquer? Give the recurrence relation for divide and conquer.	Understand	7
PART – B (LONGANSWER QUESTIONS)			
1	**Write** binary search algorithm and analyze its time complexity	Understand	7
2	**Explain** quick sort algorithm and simulate it for the following data 20, 5,10,16 ,54 ,21	Apply	7
3	**Illustrate** merge sort algorithm and discuss time complexity	Understand	7
4	**Describe** strassen's matrix multiplication.	Understand	7
5	**Sort** the list of numbers using merge sort: 78, 32, 42, 62, 98, 12, 34, 83	Apply	7

S. No	Question	Blooms Taxonomy Level	Program Outcome
UNIT – II			
PART – A (SHORT ANSWER QUESTIONS)			
1	**Discuss about** union operation on sets	Knowledge	5
2	**Describe** AND/OR graph	Understand	5
3	**Explain** game tree	Understand	5
4	**Define** a connected and bi-connected component.	Knowledge	5
5	**Define** an articulation point?	Knowledge	5
PART – B (LONGANSWER QUESTIONS)			
1	**Discuss** various tree traversal techniques with examples	Understand	5
2	**Discuss about** weighting rule for finding UNION of sets and collapsing rule	Understand	5
3	**Differentiate** divide and conquer and greedy method	Understand	6,7
4	**Discuss** game trees	Understand	5
5	**Compare** and contrast BFS and DFS.	nalyze	5

No	Question	Blooms Taxonomy Level	Program Outcome
UNIT – III			
PART – A (SHORT ANSWER QUESTIONS)			
1	**Define** greedy method	Know edge	8
2	**State** Prim;s algorithm	Knowledge	8

3	**What** is job sequencing with deadlines problem	Know edge	8
4	**State** the principle of optimality	Know edge	8
5	**Define** minimum cost spanning tree	Know edge	8
PART – B (LONGANSWER QUESTIONS)			
1	**Discuss** single source shortest path problem with example	Apply	8
2	**Discuss** kruskals algorithm with an example	Understand	8
3	**Write** an algorithm knapsack problem .Give example	Apply	8
4	**Explain** prims algorithm with an example	Understand	8
5	**Compute** the optimal solution for knapsack problem using greedy method N=3, M= 20, (p1,p2,p3)= (25,24,15), (w1,w2,w3) =(18,15,10)	Apply	8

No	**Question**	**Blooms Taxonomy Level**	**Program Outcome**
UNIT – IV			
PART – A (SHORT ANSWER QUESTIONS)			
1	**Write** an algorithm for optimal binary search tree Give example	Apply	8
2	**Explain** 0/1 knapsack problem with example	Understand	8
3	**Discuss** all pairs shortest path problem with an example	Understand	8
4	**Explain** 8 – Queens problem	Understand 1	10
5	**Define** Sum of Subsets problem	Understand 1	10
PART – B (LONGANSWER QUESTIONS)			
1	**Describe** the travelling salesman problem and discuss how to solve it using dynamic programming?	Understand	9
2	**Explain** the concept Chained matrix multiplication.	Apply	8
3	**Solve** the solution for 0/1 knapsack problem using dynamic programming(p1,p2,p3, p4) = (11, 21, 31, 33), (w1, w2, w3, w4) = (2, 11, 22, 15), M=40, n=4	Apply	8
4	**Use** optimal binary search tree algorithm and compute wij, cij, rij, 0<=i<=j<=4,p1=1/10, p2=1/5, p3=1/10, p4=1/120, q0=1/5, q1=1/10, q2=1/5, q3=1/20,q4=1/20.	Apply	8
5	**Discuss** all pairs shortest path problem with an example	Understand	8

No	**Question**	**Blooms Taxonomy Level**	**Program Outcome**
UNIT – V			
PART – A (SHORT ANSWER QUESTIONS)			
1	**Define** a dead node	Knowledge	10
2	**Differentiate** live node and dead node	Knowledge	10
3	**Compare** NP-hard and NP-completeness	Knowledge	10
4	**Define** deterministic problem	Understand	12
5	**Define** maxclique problem?	Understand	12

PART – B (LONGANSWER QUESTIONS)			
1	**Explain** the principle of FIFO branch and bound	Apply	11
2	**Explain** the method of reduction to solve travelling sales person problem using branch and bound	Apply	11
3	**Write** non deterministic algorithm for sorting and searching	Understand	12
5	**What is** chromatic number decision problem and clique decision problem	Apply	12

XI. OBJECTIVE QUESTIONS: JNTUH

UNIT-I

1. In analysis of algorithm, approximate relationship between the size of the job and the amount of work required to do is expressed by using _____

(a) Central tendency (b) Differential equation (c) Order of execution (d) Order of magnitude (e) Order of Storage.

Ans :Order of execution

2. Worst case efficiency of binary search is

(a) log2 n + 1 (b) n (c) N2 (d) 2n (e) log n.

Ans : log2 n + 1

3. For analyzing an algorithm, which is better computing time?

(a)O (100 Log N) (b) O (N) (c)O (2N) (d) O (N logN) (e) O (N2).

Ans :O (100 Log N)

4. Consider the usual algorithm for determining whether a sequence of parentheses is balanced. What is the maximum number of parentheses that will appear on the stack AT ANY ONE TIME when the algorithm analyzes: (()(()))

(a) 1 (b)2 (c)3 (d) 4

Ans :3

5. Breadth first search _____

(a) Scans each incident node along with its children. (b) Scans all incident edges before moving to other node. (c) Issame as backtracking (d) Scans all the nodes in random order.

Ans :Scans all incident edges before moving to other node.

6. Which method of traversal does not use stack to hold nodes that are waiting to be processed?

(a) Dept First (b) D-search (c)Breadth first (d) Back-tracking

Ans :Breadth first

7. The Knapsack problem where the objective function is to minimize the profit is_____

(a) Greedy (b) Dynamic 0 / 1 (c) Back tracking (d) Branch & Bound 0/1

Ans :Branch & Bound 0/1

8. Choose the correct answer for the following statements:

I. The theory of NP–completeness provides a method of obtaining a polynomial time for NPalgorithms.

II. All NP-complete problem are NP-Hard.

(a) I is FALSE and II is TRUE (b) I is TRUE and II is FALSE (c) Both are TRUE (d) Both are FALSE

Ans :I is FALSE and II is TRUE

9. If all c(i, j)'s and r(i, j)'s are calculated, then OBST algorithm in worst case takes one of the following time.

(a) O(n log n) (b) O(n3) (c) O(n2) (d) O(log n) (e) O(n4).

Ans : O(n3)

10. The upper bound on the time complexity of the nondeterministic sorting algorithm is

(a) O(n) (b) O(n log n) (c) O(1) (d) O(log n) (e) O(n2).

Ans: O(n)

11. The worst case time complexity of the nondeterministic dynamic knapsack algorithm is
(a) O(n log n) (b) O(log n) (c) O(n2) (d) O(n) (e) O(1).

Ans :O(n)

12. Recursive algorithms are based on
(a) Divideand conquer approach (b) Top-down approach (c) Bottom-up approach (d) Hierarchical approach

Ans :Bottom-up approach

13. What do you call the selected keys in the quick sort method?
(a) Outer key (b)Inner Key (c) Partition key(d) Pivot key (e) Recombine key.

Ans :c

14. How do you determine the cost of a spanning tree?
(a) By the sum of the costs of the edges of the tree (b) By the sum of the costs of the edges and vertices of the tree
(c) By the sum of the costs of the vertices of the tree (d) By the sum of the costs of the edges of the graph
(e) By the sum of thecosts of the edges and vertices of the graph.

Ans :By the sum of the costs of the edges of the tree8.

15. The time complexity of the normal quick sort, randomized quick sort algorithms in the worst case is
(a) O(n2), O(n log n) (b) O(n2), O(n2) (c) O(n log n), O(n2) (d) O(n log n), O(n log n) (e) O(n log n), O(n2 log n).

Ans :O(n2), O(n2)

16. Let there be an array of length 'N', and the selection sort algorithm is used to sort it, how many times a swap function is called to complete the execution?
(a) N log N times (b) log N times (c) N2 times (d) N-1 times (e) N times.

Ans :N-1 times

17. The Sorting methodwhich is used for external sort is
(a) Bubble sort (b) Quick sort (c) Merge sort (d) Radix sort (e) Selection sort.

Ans :Radix sort

18. The graph colouringalgorithm's time can be bounded by _____
(a) O(mnm) (b) O(nm) (c) O(nm. 2n) (d) O(nmn).

Ans :O(nmn).

19. Sorting is not possible by using which of the following methods?
(a) Insertion (b) Selection (c) Deletion (d) Exchange

Ans :Deletion

20. What is the type of the algorithm used in solving the 8 Queens problem?
(a)Backtracking (b) Dynamic (c) Branch and Bound (d) DandC

Ans :Backtracking

UNIT-II

1. Name the node which has been generated but none of its children nodes have been generated in state space tree of backtracking method.
(a) Dead node (b) Live node (c) E-Node (d) State Node

Ans: Livenode

2. How many nodes are there in a full state space tree with n = 6?
(a) 65 (b) 64 (c) 63 (d) 32

Ans : 63

3. This algorithm scans the list by swapping the entries whenever pair of adjacent keys are out of desired order.
(a) Insertion sort. (b) Bubble sort. (c) Shell sort. (d) Quick sort.

Ans: Bubble sort.

5. From the following chose the one which belongs to the algorithm paradigm other than to which others from the following belongs to.

(a) Minimum & Maximum problem. (b) Knapsack problem. (c) Selection problem.(d) Merge sort.

Ans: Knapsack problem.

6. To calculatec(i, j)'s, w(i, j)'s and r(i, j)'s; the OBST algorithm in worst case takes the following time.

(a) O(log n) (b) O (n4) (c) O (n3) (d) O (n log n)

Ans: O (n3)

7. What is the type of the algorithm used in solving the 4 Queens problem?

(a) Greedy (b) Dynamic (c) Branch and Bound (d) Backtracking.

Ans: Backtracking.

8.In Knapsack problem, the best strategy to get the optimal solution, where Pi, Wi is the Profit, Weight associated with each of the Xi h object respectively is to

(a) Arrange the values Pi/Wi in ascending order (b) Arrange the values Pi/Xi in ascending order

(c) Arrange the values Pi/Wi in descending order (d) Arrange the values Pi/Xi in descending order

Ans: Arrange the values Pi/Xi in descending order

9.Greedy job scheduling with deadlines algorithms' complexity is defined as

(a) O(N) (b) Ω(n log n) (c) O (n2 log n) (d) O (n log n)

Ans: O(N)

12 From the following choose the one which belongs to the algorithm paradigm other than to which others from the following belongs to.

(a) Minimum & Maximum problem (b) Knapsack problem(c) Selection problem (d) Merge sort

Ans : Knapsack problem

14. Identify the name of the sorting in which time is not proportional to n2.

(a) Selection sort (b) Bubble sort (c) Qucik sort (d) Insertion sort.

Ans : Insertion sort

15. The optimal solution to a problem is a combination of optimal solutions to its subproblems. This is known as

(a) Principleof Duality (b) Principle of Feasibility (c) Principle of Optimality (d) Principle of Dynamicity.

Ans : Principle of Optimality

16. Which of the following versions of merge sort algorithm does uses space efficiently?

(a) Contiguous version (b) Array version (c) Linked version (d) Structure version (e) Heap version.

Ans : Linked version

17. Identify the correct problem for multistage graph from the list given below.

(a) Resource allocation problem (b) Traveling salesperson problem

(c) Producer consumer problem (d) Barber's problem

Ans : Resource allocation problem

18. How many edges are there in a Hamiltonian cycle if the edge cost is 'c' and the cost of cycle is 'cn'

(a)c (b) cn (c)n (d) 2c

Ans :n.

19. A problem L is NP-complete iff L is NP-hard and

(a) L ≈ NP (b) L α NP (c) L ε NP (d) L = NP

Ans : L ε NP

20. What would be the cost value for any answering node of a sub tree with root 'r' using branch-bound algorithm?

(a) Maximum (b) Minimum (c) Optimal (d) Average

Ans: Minimum

UNIT-III

1. From the following pick the one which does not belongs to the same paradigm to which others belongs to.

(a) Minimum & Maximum problem (b) Knapsack problem

(c) Selection problem (d) Merge sort

Ans:Knapsack problem

2. Primsalgorithm is based on _____ method

a. Divide and conquer method c. Dynamic programming

b. Greedy method d. Branch and bound

Ans. Greedy Method

3. The amount of memory needs to run to completion is known as_____

a. Space complexity c. Worst case

b. Time complexity d. Best case

Ans: Space complexity

4. The amount of time needs to run to completion is known as_____

a. Space complexity c. Worst case

b. Time complexity d. Best case

Ans: Time complexity

5. _____ is the minimum number of steps that can executed for the given parameters

a. Average case c. Worst case

b. Time complexity d. Best case

Ans: Best case

6. _____ is the maximum number of steps that can executed for the given parameters

a. Average case c. Worst case

b. Time complexity d. Best case

Ans:Worst case

7. _____ is the average number of steps that can executed for the given parameters

a. Average case c. Worst case

b. Time complexity d. Best case

Ans: Average Case

8. Testing of a program consists of 2 phases which are _____and _____

a. Average case & Worst case b. Time complexity & Space complexity

c. Validation and checking errors d. Debugging and profiling

Ans: Debugging and profiling

9. Worst case time complexity of binary search is _____

a. O(n) b. O(logn)c. Θ(nlogn) d. Θ(logn)

Ans: Θ(logn)

10. Best case time complexity of binary search is _____

a. O(n) c. Θ(nlogn)

b. O(logn) d. Θ(logn)

Ans: Θ(logn)

11. Average case time complexity of binary search is _____

a. O(n) c. Θ(nlogn)

b. O(logn) d. Θ(logn)

Ans: Θ(logn)

12. Merge sort invented by _____
a. CARHOARE c. HAMILTON
b. JOHN VON NEUMANN d. STRASSEN
Ans : JOHN VON NEUMANN
13. Quick sort invented by _____
a. CARHOARE c. HAMILTON
b. JOHN VON NEUMANN d. STRASSEN
Ans : CARHOARE
14. Worst case time complexity of Quick sort is _____
a. O(n2log7) c. O(nlogn)
b. O(n2) d. O(logn)
Ans : O(n2)
15. Best case time complexity of Quick sort is _____
a. O(n2logn) c. O(nlogn)
b. O(logn) d. O(logn2)
Ans : O(nlogn)
16. Average case time complexity of Quick sort is _____
a. Θ (nlogn) b. O(logn)c. O(nlogn) d. Θ(logn) Ans : O(nlogn)
17. Which design strategy stops theexecution when it find the solution otherwise starts the problem from top
a. Back tracking c. Divide and conquer
b. Branch and Bound d. Dynamic programming
Ans: Back Tracking
18. Graphical representation of algorithm is _____
a. Pseudo-code c. Graph Coloring
b. Flow Chart d. Dynamic programming
Ans: Flow Chart
19. In pseudo-code conventions input express as _____
a. input c. Read
b. Write d. Return
Ans : Write
20. In pseudo-code conventions output express as _____
a. input c. Read
b. Write d. Return
Ans : Read
UNIT-IV
1. Tight bound is denoted as _____
a. Ω c. Θ
b. Ω d. O
Ans : Θ
2. Upper bound is denoted as _____
a. Ω c. Θ
b. ω d. O
Ans : O
3. lower bound is denoted as _____
a. Ω c. Θ
b. ω d. O
Ans :Ω
4. The function f(n)=o(g(n)) if and only if Limit f(n)/g(n)=0n->∞
a. Little oh b. Little omega

b. Big oh d. Omega
Ans : Little oh
5. The functionf(n)=o(g(n)) if and only if Limit g(n)/f(n)=0 n->∞
a. Little oh b. Little omega
b. Big oh d. Omega
Ans : Little omega
6. Thegeneralcriteriaof algorithm;zero or more quantities are externally supplied is_____
a. Output b. Finiteness
b. Effectiveness d. Input
Ans : Input
7. The general criteria of algorithm; at least one quantity is produced _____
a. Output b. Finiteness
b. Effectiveness d. Input
Ans : Output
8. The general criteria of algorithm; Each instruction is clear and unambiguous _____
a. Output b. Definiteness
b. Effectiveness d. Input
Ans : Definiteness
9. The general criteria of algorithm; algorithm must terminates after a finite number of steps _____
a. Output b. Finiteness
b. Effectiveness d. Input
Ans : Finiteness
10. Which is not a criteria of algorithm
a. Input b. Output
b. Time complexity d. Best case
Ans : Best case
11. Which is not in general criteria of algorithm
a. Input b. Output
b. Time complexity d. Effectiveness
Ans : Time complexity
12. Time complexity of given algorithm

```
Algorithm Display(A)
{
S:=0.0;
For i:=0 to n-1
{
S:=S+A[i];
Return S;
}
}
```

a. 4n+4 c. 4n2+4
b. 2n2+2n+2 d. 4n+4
Ans : 4n+4
13. Time complexity of given algorithm

```
AlgorithmSum(A,S)
{
for i:=1 to n-1
{
for j:=2 to n-1
```

{
S:=S+i+j;
return S;
}
}
}
a. 6n2-14n+4 c. 4n2+6n+12
b. 6n2+14n+10 d. 6n2-14n+10
Ans :6n2-14n+10
14. kruskal algorithm is based on _____method
a. Divide and conquer method b. Greedy methodc. Dynamic programming d. Branch and bound
Ans. Greedy method
15. Prims algorithm is based on _____ method
a. Divide and conquer method c. Dynamic programming
b. Greedy method d. Branch and bound
Ans. Greedy Method
16. The output of Kruskal and Prims algorithm is _____
a. Maximum spanning tree c. Spanning tree
b. Minimum spanning tree d. None of these
UNIT-V
1. job sequencing with deadline is based on _____method
a. greedy method c. branch and bound
b. dynamic programming d. divide and conquer
Ans. Greedy method
2. fractional knapsack is based on _____method
a. greedy method c. branch and bound
2 8 7 1 3 5 6 4b. dynamic programming d. divide and conquer
Ans. Greedy method
3. 0/1 knapsack is based on _____method
a. greedy method c. branch and bound
b. dynamic programming d. divide and conquer
Ans. Dynamic programming
4. The files x1,x2,x3 are 3 files of length 30,20,10 records each. What is the optimal merge pattern value?
a. 110 c. 60
b. 90 d. 50
Ans. 90
5. The optimal merge pattern is based on _____ method
a. Greedy method b. Dynamic programming
c. Knapsack method d. Branch and bound
Ans. Greedy method
6. Who invented the word Algorithm
a. Abu Ja'far Mohammed ibn Musa c. Abu Mohammed Khan
b. Abu Jafar Mohammed Kasim d. Abu Ja'far Mohammed Ali Khan
Ans. Abu Ja'far Mohammed ibn Musa
7. In Algorithm comments begin with_____
a. /* c. /
b. */ d. //
Ans : //

8. The _____ of an algorithm is the amount of memory it needs to run to completion.
a. Space Complexity c. Best Case
b. Time Complexity d. Worst Case
Ans : Space Complexity
9. _____ is the process of executing a correct program on data sets and measuring the time and space it takes tocompute the results.
a. Debugging c. Combining
b. Profiling d. Conqure
Ans : Profiling
10. In Algorithm Specification the blockes are indicated with matching _____
a. Braces c. Square Brackets
b. Parenthesis d. Slashes
Ans : Braces
11. Huffmancodes are the applications of _____ with minimal weighted external path length obtained by an optimal set.
a. BST b. MST
c. Binary tree d. Weighted Graph
Ans : Binary tree
12. From the following which is not return optimal solution
a. Dynamic programming c. Backtracking
b. Branch and bound d. Greedy method
Ans. Backtracking
13. _____ is an algorithm design method that can be used when the solution to a problem can be viewed as the result of a sequence of decisions
a. Dynamic programming c. Backtracking
b. Branch and bound d. Greedy method
Ans : Dynamic programming
14. The name backtrack was first coined by _____
a. D.H.Lehmer c. L.Baumert
b. R.J.Walker d. S. Golomb
Ans : D.H.Lehmer
15. The term _____ refers to all state space search methods in which all hildren of the – nodes are generated before any other live node can becomethe E-node.
a. Backtacking c. Depth First Search
b. Branch and Bound d. Breadth First Search
Ans ; Branch and Bound
16. A _____ is a round trip path along n edges of G that visits every vertex once and returns to its starting position.
a. MST c. TSP
b. Multistage Graph d. Hamiltonian Cycle
Ans :Hamiltonian Cycle
17. Graph Coloring is which type of algorithm design strategy
a. Backtacking c. Greedy
b. Branch and Bound d. Dynamic programming
Ans : Backtracking
18. Which of the following is not a limitation of binary search algorithm?
a. must use a sorted array
b. requirement of sorted array is expensive when a lot of insertion and deletions are needed

c. there must be a mechanism to access middle element directly
d. binary search algorithm is not efficient when the data elements are more than 1000.

Ans : binary search algorithm is not efficient when the data elements are more than 1000.

19. Binary Search Algorithm cannot be applied to
a. Sorted linked list c. Sorted linear array
b. Sorted binary tree d. Pointer array

Ans :Sorted linked list

20. Two main measures for the efficiency of an algorithm are
a. Processor and memory c. Time and space
b. Complexity and capacity d. Data and space

Ans : Time and Space

XII. GATE QUESTIONS:

1 The order of an internal node in a B+ tree index is the maximum number of children it can have. Suppose that a child pointer takes 6 bytes, the search field value takes 14 bytes, and the block size is 512 bytes. What is the order of the internal node?
A) 24 B) 25 C) 26 D) 27
Answer : (C)

2 The best data structure to check whether an arithmetic expression has balanced parentheses is a
A) queue B) stack C) tree D) list
Answer : (B)

3. A Priority-Queue is implemented as a Max-Heap. Initially, it has 5 elements. The level-order traversal of the heap is given below: 10, 8,5,3,2 Two new elements 1 and 7 are inserted in the heap in that order. The level-order traversal of the heap after the insertion of the elements is
A) 10,8,7,5,3,2,1 B) 10,8,7,2,3,1,5 C) 10,8,7,1,2,3,5 D) 10,8,7,3,2,1,5
Answer : (D)

4 The following numbers are inserted into an empty binary search tree in the given order: 10, 1, 3, 5, 15, 12, 16. What is the height of the binary search tree (the height is the maximum distance of a leaf node from the root)?
A) 2 B) 3 C) 4 D) 6
Answer : (B)

5 The goal of structured programming is to
A) have well indented programs B) be able to infer the flow of control from the compiled code C) be able to infer the flow of control from the program text D) avoid the use of GOTO statements
Answer : (C)

6 The tightest lower bound on the number of comparisons, in the worst ease, for comparison-based sorting is of the order of
A) n B) n^2 C) n log n D) $n \log^2 n$
Answer : (B)

7 Let G be a simple graph with 20 vertices and 100 edges. The size of the minimum vertex cover of G is 8. Then, the size of the maximum independent set of G is
A) 12 B) 8 C) Less than 8 D) More than 12
Answer : (A)

8 Let A be a sequence of 8 distinct integers sorted in ascending order. How many distinct pairs of sequences, B and C are there such that (i) each is sorted in ascending order, (ii) B has 5 and C has 3 elements, and (iii) the result of merging B and C gives A?

A) 2 B) 30 C) 56 D) 256
Answer : (D)
9 A Priority-Queue is implemented as a Max-Heap. Initially, it has 5 elements. The level-order traversal of the heap is given below: 10, 8,5,3,2 Two new elements 1 and 7 are inserted in the heap in that order. The level-order traversal of the heap after the insertion of the elements is
A) 10,8,7,5,3,2,1 B) 10,8,7,2,3,1,5 C) 10,8,7,1,2,3,5 D) 10,8,7,3,2,1,5
Answer : (D)
10 The S-N curve for steel becomes asymptotic nearly at
A) 10^3 cycles B) 10^4 cycles C) 10^6 cycles D) 10^9 cycles
Answer : (C)

XIII. WEBSITES:

- http://www.ki.inf.tu-dresden.de/~hans/www-adr/alg_course.html --String Matching, Sorting, Linear Programming
- http://www.algorithmist.com/index.php/Main_Page-it contains dynamic programming, greedy, ,Graph Theory, sorting, Data Structures

http://www-2.cs.cmu.edu/~guyb/realworld.html- it contains Data Compression, Indexing and Search engines, linear Programming, Pattern matching

XIV. EXPERT DETAILS:

Professor Sartaj Kumar Sahni is an Indian computer scientist, now based in the USA, and is one of the pioneers in the field of data structures. He is a distinguished professor in the Department of Computer and Information Science and Engineering at the University of Florida.

http://www.cise.ufl.edu/~sahni/

XV. JOURNALS:

1. Journal of Graph Algorithms and Applications url:http://www.emis.de/journals/JGAA/home.html
2. Algorithmica –A journal about the design of algorithms in many applied and fundamental areas http://www.springerlink.com

XVI. LIST OF TOPICS FOR STUDENT SEMINARS:

- Randomized Algorithms, Binary search, Connected components and spanning Trees
- Hamiltonian cycles, Single source shortest path problem, Non-deterministic algorithms

XVII. CASE STUDIES / SMALL PROJECTS:

1. Techniques for Algorithm Design and Analysis: Case Study of a Greedy Algorithm.

Six different implementations of a greedy dominating set algorithm are presented and analyzed. The implementations and analysis illustrate many of the important techniques in the design and analysis of algorithms, as well as some interesting graph theory.

2. Scheduling Two Salesmen in a Network.

The two-server problem is concerned with the movement of two servers to request points in a metric space. We consider an offline version of the problem in a graph in which the requests may be served in any order. A family of approximations algorithms is developed for this NP-complete problem.