Design and Analysis of Algorithms

The question bank has been prepared as a reference for students.

UNIT-1 (Part-A)

Sl. No.	Question	BL	CO
1	Define algorithm and its characteristics	1	1
2	Define space and time complexity	1	1
3	In the analysis of algorithm what do you mean by best, worst and average behavior of an algorithm	1	1
4	Define recursion and significance of base condition	1	1

5	Find the time and space complexity for the below code
	Consider the following function:
	int unknown (int n)
	{
	int i, j, k = 0;
	for (i = n/2; i <= n; i++)
	for (j = 2; j <= n; j = j*2)
	k = k + n/2;
	return (k);
	}
		1	1

6	Sort the following functions in the decreasing order of their a complexity: f1(n) = n^?n , f2(n) = 2^n, f3(n) = (1.000001)^n , f4(n) = n^(10)*2^(n/2)	1	1
7	How can we measure an algorithm's running time?	1	1
8	Show that if $f(n) = a^m n^m + ...+ a_1^n + a_0$ then $f(n) = O(n^m)$.	3	1
9	Define Order of Growth	1	1
10	Prove that $10n^2+3n+4=O(n^2)$. Find the values of n_0 and c.	3	1

UNIT-1 (Part-B)

Sl. No.	Question	BL	CO
1	The running time of an algorithm is represented by the following recurrence relation: $T(n) = \begin{cases} n & n \le 3 \\ T\left(\frac{n}{3}\right) + cn & \text{otherwise} \end{cases}$ Solve by using Substitution method, Recursion tree method and Masters' theorem.	3	1
2	Estimate the time complexity using f(n) and g(n) functions in asymptotic	2	1

	notations. Explain with an examples.		
3	Describe the Master's theorem and Solve the following recurrence relation to find the time complexity $T(n)=7T(n/2)+18n^2$.	3	1
4	What is an algorithm? Explain its characteristics and Explain the role of instance characteristics in finding the time complexities with an example.	1	1
5	Solve the following recurrence relation to find the time complexity using substitution Method $T(n)=7T(n/3)+n^2$ if $n>0$ $T(1)=1$ otherwise	3	1
6	Draw recursion tree for $T(n)=4T(n/2)+n$ and provide light asymptotic bounds.	3	1
7	Give control abstraction for divide and conquer	2	1
8	Explain how master theorem has been derived from recursive tree.	2	1

UNIT-2 (Part-A)

Sl. No.	Question	BL	CO
1	Distinguish between greedy and dynamic programming	3	4
2	Differentiate between optimal substructure and overlapping sub-problems.	2	2
3	Give the significance of dominance rules	1	2
4	Define Knapsack problem and what is the difference between 0/1 and fractional knapsack.	1	2
5	Define Huffman Codes. Which data structure is used.	1	2
6	Define Job scheduling with deadlines	1	2
7	Define Travelling Salesman Problem	1	2
8	Define Matrix chain multiplication	1	2
9	Define Longest Common subsequence	1	2
10	Define Optimal Binary search tree.	1	2
11	Define principle of optimality.	1	2

UNIT-2 (Part-B)

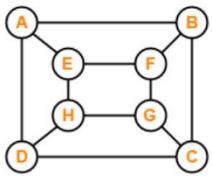
Sl. No.	Question	BL	CO
1	Describe the control abstraction for the subset paradigm of greedy method and also explain the functioning of select, feasible and union functions in the control abstraction.		
2	Describe algorithm and time complexity of fractional knapsack problem using greedy		
3	Consider the following instance of the knapsack problem: n = 6,(P1,P2,P3,P4,P5,P6) =(W1,W2,W3,W4,W5,W6)= (100,50,20,10, 7, 3),and m = 165. Find the solution using greedy approach		
4	Describe algorithm and time complexity of Job scheduling with deadlines problem using greedy		
5	What is the solution generated by function Job scheduling with deadlines algorithm when n=6 (P1…p6) = (3, 5, 20, 18, 1, 6), and (d1..d6) = (1, 3, 4, 3, 2, 1).		
6	Explain optimal binary search tree problem with proper derivations for		

	calculating minimum cost of the tree.		
7	Consider 4 elements al < a2 < a3 < a4 with q(0) = 1/ 8 , q(1) = 1 /16 , q(2) = q(3) = q(4) = 1 /16 , p(1) = 1 /4 , p(2) = 1/ 8 , p(3) = p(4) = 1/ 16. Construct the table of values of W (i, j), R (I,j) and C(i, j) computed by the OBST algorithm to compute the roots of optimal sub trees.		
8	Evaluate 0/1 knapsack problem, for greedy and dynamic programing is applied	4	4
9	Describe algorithm and time complexity of OBST		
10	Consider the following instance of the 0/1 knapsack problem n=5, (p1,p2,..,p5)=(10,15,6,8,4), (w1,w2,..,w5)=(4,6,3,4,2), and m=12. Find the solution using dynamic programming		
11	Describe algorithm and time complexity of 0/1 knapsack problem using dynamic programming		
12	Find the minimum cost of the path for the following travelling Salesman problem. $\begin{bmatrix} \infty & 5 & 1 & 10 & 6 \\ 1 & \infty & 4 & 12 & 7 \\ 3 & 6 & \infty & 4 & 16 \\ 7 & 1 & 3 & \infty & 9 \\ 16 & 12 & 7 & 6 & \infty \end{bmatrix}$		
13	Describe algorithm and time complexity of 0/1 travelling Salesman problem using dynamic programming		
14	Consider A_1=1X2, A_2=2X3, A_3=3X4, A_4=4X5 and Apply matrix chain multiplication to obtain optimal sequence.		
15	Describe algorithm and time complexity of matrix chain multiplication using dynamic programming		
16	Determine a Longest Common Subsequence of (1, 0, 0, 1, 0, 1, 0, 1) and (0, 1, 0, 1, 1, 0, 1, 1, 0).		
17	Describe algorithm and time complexity of matrix chain multiplication using dynamic programming		
18	Determine the following- Huffman code for each character, Average code length and length Huffman encoded message with the below information		

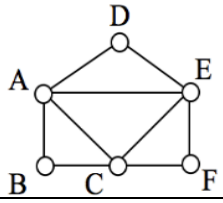
Characters	A	E	I	O	U	S	T
Frequencies	10	15	12	3	4	13	1

UNIT-3 (Part-A)

Sl. No.	Question	BL	CO
1	Draw the state space tree of 4-Queen's problem.	2	2
2	What is an articulation point?	1	2
3	Define implicit and explicit constraints with examples.	1	2
4	Difference between backtracking and branch and bound.	2	3
5	Difference between backtracking and dynamic programming.	2	3
6	How are two queens on the same diagonal identified?	1	2
7	Difference between static and dynamic trees	2	3
8	Write the applications of backtracking	1	2

9	What is planar graph and chromatic number?	1	2
10	What is a Hamiltonian cycle. Identify articulation points in the given graph. 	1	2
11	Define Live Node, E-node & Dead Node.	1	2

UNIT-3 (Part-B)

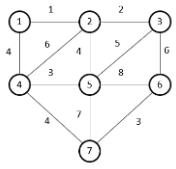
Sl. No.	Question	BL	CO
1	Draw the state space tree for 4-queens problem.	2	2
2	Write the algorithm for n-queens problem. Write the time complexity of the algorithm.	1	2
3	Write the control abstraction of Iterative/Recursive backtracking.	1	2
4	Write the control abstraction of branch and bound.	1	2
5	Apply backtracking to find all possible Hamiltonian Cycles for following graph. 	3	3
6	Explain the Graph – coloring problem. Draw the state space tree for m=3 colors n=4 vertices graph. Interpret the time and space complexity.	2	4
7	Develop the portion of the state space tree generated by FIFOBB and LCBB for the job sequencing with deadlines instance n = 5, (p1,p2,...,p5)=(6, 3,4, 8,5), (t1,t2,...,t5)=(2,1,2,1,1) and (d1,d2,...,d5)=(3, 1,4, 2, 4). What is the penalty corresponding to an optimal solution? Use a variable tuple size formulation and c(.) and u(.)	3	4
8	Write graph coloring algorithm. Write the applications of graph coloring.	1	2
9	Write an algorithm for Hamiltonian cycle. Determine the order of magnitude of the worst case computing time for backtracking procedure that finds all Hamiltonian cycle? Write the applications of Hamiltonian cycle.	3	4
10	Solve 0/1 knapsack using FIFOBB and LCBB branch and bound where (pi, p2, p3, p4) = (10, 10, 12, 18) (wi. w2, w3, w4) = (2, 4, 6, 9) M = 15		4
11	Solve travelling salesperson problem using FIFOBB and LCBB branch and bound where the cost matrix is given. Evalate the efficiency of both the methods.		4

	$\begin{bmatrix} 0 & 10 & 15 & 20 \\ 5 & 0 & 9 & 10 \\ 6 & 13 & 0 & 12 \\ 8 & 8 & 9 & 0 \end{bmatrix}$		

UNIT-4 (Part-A)

Sl. No.	Question	BL	CO
1	What are the applications of DFS.	1	2
2	What is an articulation point?	1	2
3	What are strongly connected components?	1	2
4	What is a DAG?	1	2
5	Write the applications for topological sort.	1	2
6	Write the difference between Kruskal'a and Prim's algorithm.	1	4

UNIT-4 (Part-B)

Sl. No.	Question	BL	CO
1	Write an algorithm for DFS. What is the time complexity? Explain the various applications of DFS.	2	2
2	Write Kosaraju's Algorithm to determine strongly connected components.	2	2
3	Write Kahn's algorithm for topological sorting.	2	2
4	Write dijkstra's algorithm for finding shortest path.	2	2
5	Write Bellman-ford's algorithm for finding shortest path.	2	2
6	Write Floyd-Warshall algorithm for finding shortest path.	2	2
7	Determine the algorithm which has better performance for finding the shortest path.	4	3
8	Write Johnson's algorithm for finding shortest path.	2	2
9	Write Prim's and Kruskal's algorithm for minimum spanning tree. Determine the performance of the algorithms.	2	4
10	Find minimum cost spanning tree using prim's and kruskal's for the given graph. Evaluate the performance of both the methods. 	3	5

UNIT-5 (Part-A)

Sl. No.	Question	BL	CO
1	What are intractable problems?	3	6
2	What is Reduction and what are Reduction algorithms?	4	6
3	What are the complexity classes P, NP, NP-hard, NP-complete?	4	6
4	What is a Clique?	3	6

5	What is vertex cover problem?	4	6
6	What is subset sum problem?	4	6

UNIT-5 (Part-B)

Sl. No.	Question	BL	CO
1	Prove that the Clique problem is NP-complete?	3	6
2	Give the Reduction procedure for Vertex cover problem?	4	6
3	Give a description of the relation between P,NP,CO-NP,NP-hard,NP-complete?	4	6
4	Prove that the circuit satisfiability belongs to NP class	4	6

Students should be thorough in all units and not rely solely on this question bank. It has been shared only to help you understand how questions can be asked from each unit.