Unit - I

1) If $f(n) = 5n^2 + 6n + 4$ then prove that $f(n)$ is $O(n^2)$

2) Give the recurrance equation for the worst case behaviour of merge sort.

3) Define algorithm correctness

Ans) In a theoretical computer science, an algorithm is correct with respect to a specification if it behaves as specified.

* Best explored is functional correctness, which refers to the input-output behavior of algorithm.

4) Explain the term Amortized efficiency?

Ans) Amortize analysis is used for algorithms where an occasional operation is slow, but most of the other operations are faster. In Amortized analysis we analyse a sequence of operations and generate worst case average time which is lower than the worst case time of a particular expensive operation.

5) Define order of growth?

Ans) A set of functions whose asymptotic growth behaviour is considered equivalent.

6) How do you measure the runtime of algorithm?

Ans) To calculate the running time, find the maximum number of nested loops that go through a significant portion of the input.

Time complexity in such cases is $O(nm)$

7) What is meant by divide and conquer method?

Ans) The divide and conquer technique that is used to reduce the complexity of a problem by dividing it into sub problems.

(or)

A problem is divided into smaller problems, then the smaller problems are solved independently, and finally the solutions of smaller problems are combined into a solution for the large problem

8) ~~Divide~~ Define control abstraction of divide and conquer.

Ans) A procedure whose flow of control is clear but whose primary operations are specified by other procedures whose precise meanings are left undefined.

9) List out any two draw backs of Binary Search algorithm.

Ans) * It employs recursive approach which requires more stack.

* Programming binary search algorithm is error prone and difficult.

* The interaction of binary search with memory hierarchy i.e catching is poor.

10) Draw backs of mergesort.

* Extra space to store subarrays
* Slow for small array.
* The algorithm does the whole process even the array is already sorted.

Unit-2

1) Applications of greedy method.

Ans) CPU scheduling algorithms
Minimum spanning trees
Dijkstra shortest path algorithm
Fit algorithm in memory management
Travelling salesman problem
Fractional knapsack problem

2) Define feasible solution?

Ans) A feasible solution is a set of values for the decision variables that satisfies all of the constraints in an optimization problem. The set of all feasible solutions defines the feasible region of the problem.

3) Define optimal solution.

Ans) An optimal solution is a feasible solution where the objective function reaches its maximum value - for example, the most profit or the least cost. A globally optimal solution is one where there are no other feasible solutions with better objective function values.

(4) State the time complexities of prims and kruskals algorithms.

Sol) The time complexity is $O(V \log V + E \log V) = O(E \log V)$, making it the same as kruskal's algorithm. However prims algorithm can be improved using fibonacci heaps to $O(E + \log V)$

(5) Define minimum cost spanning tree.

Ans) MST is a subset of edges of a connected weighted undirected graph that connects weighted undirected graph connects all the vertices together with the minimum possible total edge weight. To derive an MST, prims algorithm or kruskals algorithm can be used.

6) Dynamic programming.

Ans) It is a technique that breaks the problem into sub-problems and saves the result for future purposes that we do not need to compute the result again. The subproblems are optimized to optimize the overall is known as optimal substructure property.

7) State the principle of optimality?

Ans) The principle of optimality is the basic principle of dynamic programming, which was developed by Richard Bellman, that an optimal path has the property that whatever the initial conditions and control variables over some initial period, the control chosen over the remaining period.

8) List the features of dynamic programming,

Ans) The D.P is applicable that are having properties such as
* Those problems that are having overlapping sub problems and optimal substructures. Here, optimal substructure means that the solution of optimization problems can be obtained by simply combining the optimal solution of all the sub problems.

a) Difference b/w greedy & dynamic programming.

Greedy Method	Dynamic Programming
* An algorithm that follows the problem-solving heuristic of making the locally optimal choice at each stage with the intent of finding a global optimum	* An algorithm that helps to efficiently solve a class of problems that have overlapping subproblems and optimal substructure property.
* Less efficient	* More efficient
* First makes a choice that looks best at the time and then solves a resulting subproblem.	* Solves all subproblems and then select one that helps to find optimal solution.
* Makes decisions considering first stage	* Makes decisions at every stage

10) Define dominance rule.

Sol) A dominance rule is established in order to reduce the solution space of a problem by adding new constraints to it, either as a procedure that aims to reduce the do-mains of variables, or directly in building interesting solutions. Dominance rules have been extensively used over the last fifty years.

Unit-3

1) What is search?

Ans) Finding the desired element.

2) Traverse: visiting all the vertices

3) What is inorder, preorder and postorder traversal technique?

Ans) Inorder: (Left, Root, Right)

Preorder: (Root, left, right)

Postorder: (Left, right, root)

4) Listout graph traversal techniques?

Ans) BFS (Breadth First Search)

DFS (Depth First Search)

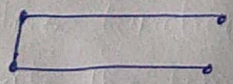
5) Define connected component.

Ans) It is a collection of all vertices such that there should be a path between every pairs of vertices.

6) Biconnected Components: the graph which do not form articulation point are called as biconnected components.

7) Difference b/w connected graph and disconnected graph

Connected Graph	Disconnected Graph.
* If every pair of vertices in the graph is connected	* A undirected graph that is not connected is called disconnected graph.



8) Which data structure are used for implementing the breadth first search and depth first search

Ans) BFS - Queue

DFS - stack

9) List the binary tree traversal techniques?

Ans) 1. Preorder
2. Postorder
3. Inorder

10) Define an articulation point.

Ans) If you remove a vertex from the graph then you get a different graph and that particular points are called as articulation point (or) cut vertex.

Unit-4

1) State the principle of Backtracking.

Ans) Backtracking is a technique based on algorithm to solve problem. It uses recursive calling to find the solution by building a solution step by step increasing values with time. It removes the solutions that doesn't give rise to the solution of the problem based on the constraints given to solve the problem.

2) Write control abstraction for backtracking.

Ans) Control abstraction of backtracking Programming Technique Abstract: Backtracking is a well known technique for solving combinatorial problem. This paper applies a programming methodology, which we call control structure abstraction, to the background technique.

3) List applications of Backtracking

Ans) 1. N-Queen problem
2. Hamiltonian cycle problem
3. Graph colouring problem
4. Subset-sum problem
5. knapsack problem
6. Constraint satisfaction problem such as crossword, verbal arithmatic etc
7. Efficient technique for parsing.

4) Define a dead node.

Ans) Dead node is a generated node that is not to be expanded or explored any further. All children of a dead node have already been expanded.

5) Differentiate live node and dead node

Ans)

Live node	Dead node
* A node which has been generated and all of whose children are not yet been generated.	* A generated node that not to be expanded or explored any further.

*

6) Define state space tree.

Ans) A state space tree is the tree of the construction of the solution from partial solution starting with the root with no component solution (...)

7) Define solution space.

Ans) • Solution space is a set that includes at least one solution to the problem.

• subset problem

• n=2, {00, 01, 10, 11}

• n=3 · {000, 001, 010, 100, 011, 101, 110, 111}

• Solution space for subset problem has 2^n members.

• Non systematic search of the space for the answer takes $O(2^n)$ time

8) Define solution states and answer states

Ans) Solution states:- Solution states are those states leading to a tuple in the solution space.

Answer state:- Answer states are those problem states s for which the path from the root to s defines a tuple which is the member of the set of solutions (i.e satisfies implicit constraints).

a) Define 8-queen problem.

Ans) The eight queens problem is the problem of placing eight queens on an 8x8 chessboard such that none of them attack one another (no two are in the same row, column or diagonal). More generally ithe n queens problem places n queens on an nxn chessboard.

10) State sum of subsets problem.

Ans) Subset sum problem is to find subset of elements that are selected from given set whose sum adds up to a given number k. We are considering the set contains non-negative values. It is assumed that the input set is unique (no duplicates are presented).

Unit-5-shorts

1) Define class P

Ans) The class P consists of those problems that are solvable in polynomial time, i.e, these problems can be solved in time $O(n^k)$ in worst-case, where k is constant.

These problems are called tractable, while others are called intractable or superpolynomial. Formally, an algorithm is polynomial time algorithm, if there exists a polynomial p(n) such that the algorithm can solve any instance of size n in a time O(p(n)).

2) Compare NP Hard and NP completeness?

Ans)

	NP Hard	NP complete
Description	NP-Hard problems can be solved if and only if there is a NP-complete problem (say Y) can be reducible into X in polynomial time	NP-complete problems can be solved by deterministic algorithm in polynomial time!
Solution	To solve this problem, it must be a NP problem	To solve this problem, it must be both NP and NP-hard problem
Nature	It is not a decision problem	It is exclusively a decision problem.

3) Define NP-hard problem.

Ans) A problem is NP-hard if an algorithm for solving it can be translated into one for solving any NP-problem (non-deterministic polynomial time) problem. NP-hard therefore means "at least as hard as any NP-problem", although it might, in fact, be harder.

4) Define NP-complete problem

Ans) NP-complete problem, any of a class of computational problems for which no efficient solution algorithm has been found. Many significant computer-science problems belong to this class - e.g., the sales person problem, satisfiability problems and graph-covering problems.

5) Define Deterministic problem?

Ans) A deterministic algorithm is an algorithm that, given a particular input, will always produce the same output, with the underlying machine always passing through the same sequence of states.

6) Define Non-deterministic problem.

Ans) Non-deterministic algorithms are used in solving problems which allow multiple outcomes. Every outcome the non-deterministic algorithm produces is valid, regardless of the choices made by the algorithm during execution.

7) Define a decision problem?

Ans) A decision problem is a problem that can be posed as a yes-no question of the input values. An example of a decision problem is deciding whether a given natural number is prime. A decision problem which can be solved by an algorithm is called decidable.

8) ~~Define~~ Explain Optimization problem.

Ans) An optimization problem is the problem of finding the best solution from all feasible solutions. Optimization problems can be divided into two categories, depending on whether the variables are continuous or discrete.

a) Explain Maxclique problem?

Ans) Maxclique problem is a non-deterministic algorithm. In this algorithm, first we try to determine a set of k distinct vertices and then we try to test whether these vertices form a complete graph. There is no polynomial time deterministic algorithm to solve this problem. This problem is NP complete.

10) Define vertex cover problem.

Ans) In graph theory, a vertex cover of a graph is a set of vertices that includes at least one endpoint of every edge of the graph. The problem of finding a minimum vertex cover is a classical optimization problem. It is NP-hard, so it cannot be solved by a ~~prob~~ polynomial-time algorithm if $P \neq NP$.