# INSTITUTE OF AERONAUTICAL ENGINEERING

**(Autonomous)**

Dundigal, Hyderabad -500 043

## COMPUTER SCIENCE AND ENGINEERING

## TUTORIAL QUESTION BANK
**2016 - 2017**

| | | |
|---|---|---|
| **Course Name** | : | **DESIGN AND ANALYSIS OF ALGORITHMS** |
| **Course Code** | : | A40508 |
| **Class** | : | II B. Tech II Semester |
| **Branch** | : | Computer Science and Engineering |
| **Year** | : | 2016 – 2017 |
| **Course Faculty** | : | Dr. L V Narasimha Prasad Professor, Mr. Y Subba Rayudu Assistant Professor Mrs. G.Vasavi Assistant Professor . |

**OBJECTIVES**

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process.

## PART – A (SHORT ANSWER QUESTIONS)

| S. No | Question | Blooms Taxonomy Level | Program Outcome |
|---|---|---|---|
| | **UNIT – I** | | |
| 1 | **Define** the term algorithm and state the criteria the algorithm should satisfy. | Knowledge | 1 |
| 2 | **Write** order of an algorithm and the need to analyze the algorithm. | Knowledge | 2 |
| 3 | **Define** asymptotic notations: big 'Oh', omega and theta? | Knowledge | 2 |
| 4 | **List** the two different types of recurrence | Knowledge | 4 |
| 5 | **State** the best case and worst case analysis for linear search | Knowledge | 7 |
| 6 | If $f(n)=5n^2 + 6n + 4$, then **prove** that f(n) is $O(n^2)$ | Apply | 3 |
| 7 | **Give** the recurrence equation for the worst case behavior of merge sort. | Knowledge | 7 |
| 8 | **Compute** the average case time complexity of quick sort | Apply | 7 |
| 9 | **Define** algorithm correctness | Knowledge | 3 |
| 10 | **Describe** best case, average case and worst case efficiency of an algorithm? | Understand | 3 |
| 11 | **Explain** the term amortized efficiency | Understand | 3 |

| S. No | Question | Blooms Taxonomy Level | Program Outcome |
|---|---|---|---|
| 12 | **Define** order of growth | Knowledge | 2 |
| 13 | **How** do you measure the algorithm running time? | Understand | 1 |
| 14 | **Describe** the role of space complexity and time complexity of a program ? | Knowledge | 1 |
| 15 | **Explain** algorithm design technique? | Understand | 3 |
| 16 | **Use** step count method and analyze the time complexity when two n×n matrices are added | Apply | 3 |
| 17 | **What** is meant by divide and conquer? Give the recurrence relation for divide and conquer. | Understand | 7 |
| 18 | **Define** Control Abstraction and write the computing time of divide and conquer. | Knowledge | 7 |
| 19 | **List** out any two drawbacks of binary search algorithm. | Knowledge | 7 |
| 20 | **What** are the drawbacks of Merge Sort algorithm. | Knowledge | 7 |

## PART – B (LONGANSWER QUESTIONS)

| S. No | Question | Blooms Taxonomy Level | Program Outcome |
|---|---|---|---|
| 1 | **Discuss** various the asymptotic notations used for best case average case and worst case analysis of algorithms. | Understand | 1 |
| 2 | **Differentiate** between priori analysis and posteriori analysis. | Understand | 3 |
| 3 | **Write** binary search algorithm and analyze its time complexity | Understand | 7 |
| 4 | **Explain** quick sort algorithm and simulate it for the following data 20, 35, 10, 16, 54, 21, 25 | Apply | 7 |
| 5 | **Discuss** Iterative binary search algorithm | Understand | 7 |
| 6 | **Illustrate** merge sort algorithm and discuss time complexity | Understand | 7 |
| 7 | **Describe** strassen's matrix multiplication. | Understand | 7 |
| 8 | **Explain** amortized analysis | Understand | 3 |
| 9 | **Explain** probabilistic analysis | Understand | 3 |
| 10 | **Sort** the list of numbers using merge sort: 78, 32, 42, 62, 98, 12, 34, 83 | Apply | 7 |

## PART – C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)

| S. No | Question | Blooms Taxonomy Level | Program Outcome |
|---|---|---|---|
| 1 | **Solve** the following recurrence relation $T(n) = \begin{cases} 2T\left(\frac{n}{2}\right) + n, & and\ T(1) = 2 \end{cases}$ | Apply | 4 |
| 2 | **Solve** the following recurrence relation $T(n) = 7T(n/2)+cn^2$ | Apply | 4 |
| 3 | **Solve** the recurrence relation $T(n) = \begin{cases} k, & n = 1 \\ 3T\left(\frac{n}{2}\right) + kn, & n > 1, \quad n\ is\ power of\ 2 \end{cases}$ | Apply | 4 |
| 4 | **Explain** quick sort algorithm and simulate it for following data sequence: 3 5 9 7 1 4 6 8 2 | Apply | 7 |
| 5 | **Sort** the list of numbers using merge sort 33, 44, 2, 10, 25, 79, 86, 47, 14, 36 | Apply | 7 |
| 6 | **Show** that the average case time complexity of quick sort is O(nlogn) | | 7 |

| S. No | Question | Blooms Taxonomy Level | Program Outcome |
|---|---|---|---|
| 7 | **Apply** merge sort on letters H, K, P,C,S,K,R,A,B,L | Apply | 7 |
| 8 | **Apply** strassen's matrix multiplication on following matrices $\begin{bmatrix} 4 & 5 \\ 5 & 9 \end{bmatrix}, \begin{bmatrix} 2 & 10 \\ 1 & 6 \end{bmatrix}$ | Apply | 7 |
| 9 | **Write** and solve recurrence relation for strassen's matrix multiplication | Apply | 7 |
| 10 | **Solve** the following recurrence relation $T(n) = \left\{2T\left(\frac{n}{2}\right) + 1, \quad and\ T(1) = 2\right.$ | Apply | 4 |

**UNIT-II**

**PART – A (SHORT ANSWER QUESTIONS)**

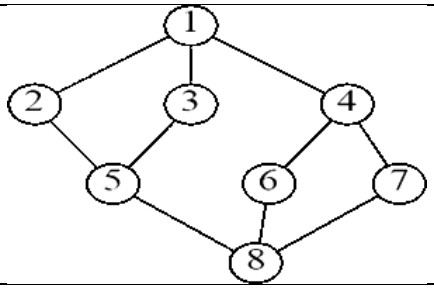
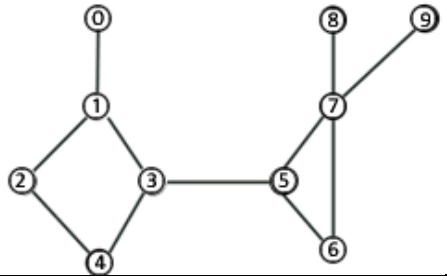
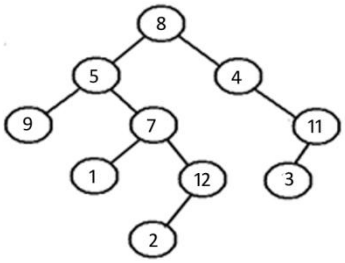
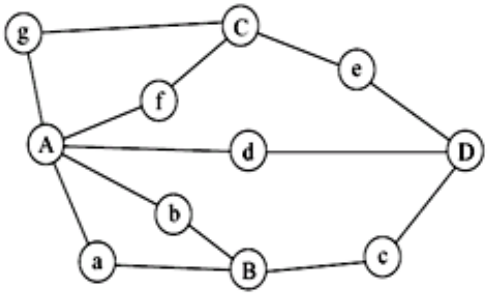
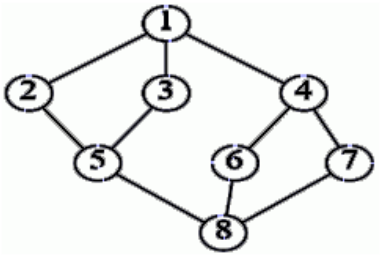
| S.No | Question | Blooms Taxonomy Level | Program Outcome |
|---|---|---|---|
| 1 | **Discuss about** union operation on sets | Knowledge | 5 |
| 2 | **Describe** find operation on sets | Knowledge | 5 |
| 3 | **Define** spanning tree and minimal spanning tree | Knowledge | 6 |
| 4 | **What** do mean by depth first search | Knowledge | 5 |
| 5 | **Define** breadth first search | Knowledge | 5 |
| 6 | **Differentiate** Breadth first search and depth first search | Analyze | 5 |
| 7 | **Describe** AND/OR graph | Knowledge | 5 |
| 8 | **Explain** game tree | Understand | 5 |
| 9 | **Define** an articulation point? | Knowledge | 5 |
| 10 | **Define** a connected and bi-connected component. | Knowledge | 5 |

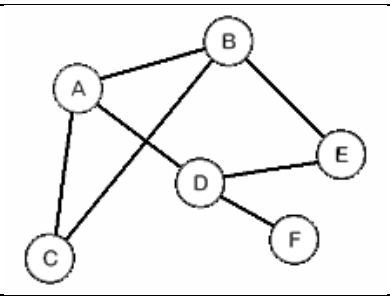
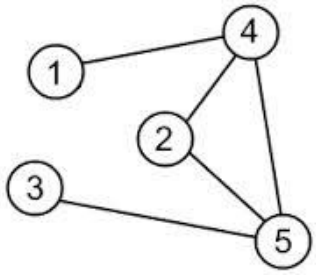
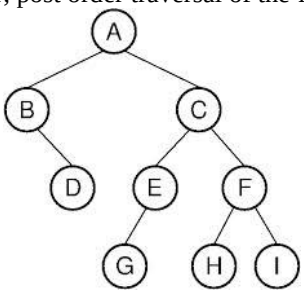
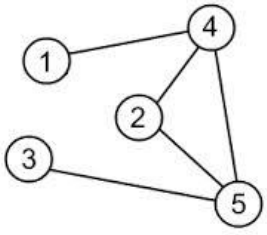
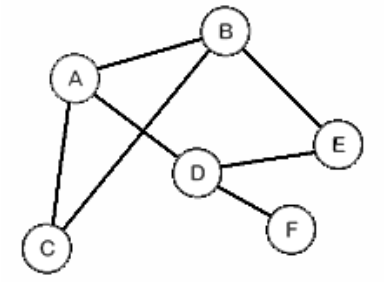
**PART – B (LONGANSWER QUESTIONS)**

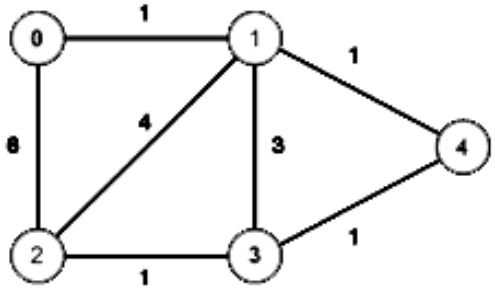
| S.No | Question | Blooms Taxonomy Level | Program Outcome |
|---|---|---|---|
| 1 | **Write an algorithm for** breadth first search . Give example | Understand | 5 |
| 2 | **Explain** depth first search algorithm with example | Understand | 5 |
| 3 | **Discuss** various tree traversal techniques with examples | Understand | 5 |
| 4 | **Compare** and contrast BFS and DFS. | Analyze | 5 |
| 5 | **Explain** in detail about AND/OR graphs | Understand | 5 |
| 6 | **Discuss about** weighting rule for finding UNION of sets and collapsing rule | Understand | 5 |
| 7 | **Differentiate** divide and conquer and greedy method | Understand | 6,7 |
| 8 | **Discuss** game trees | Understand | 5 |

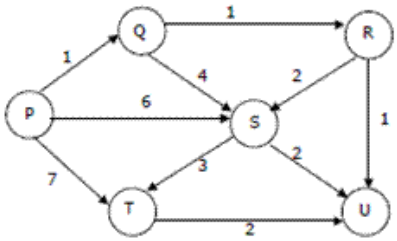
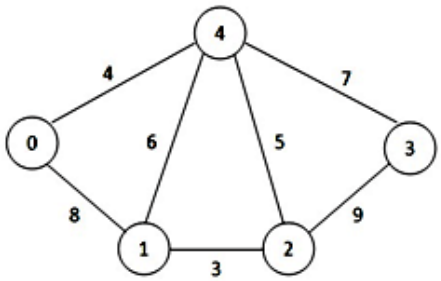
**PART – C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)**

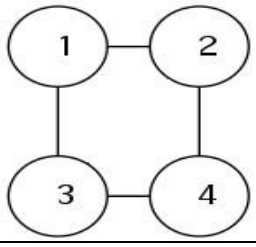
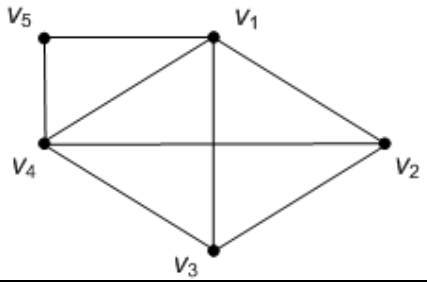
| | | | |
|---|---|---|---|
| 1 | **Solve** BFS traversal of following graph | Understand | 5 |

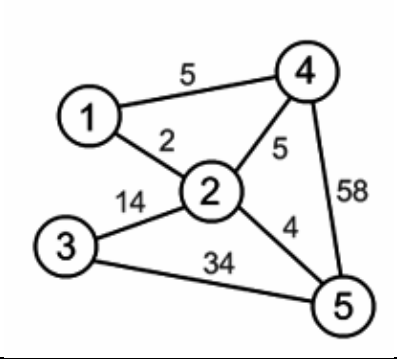
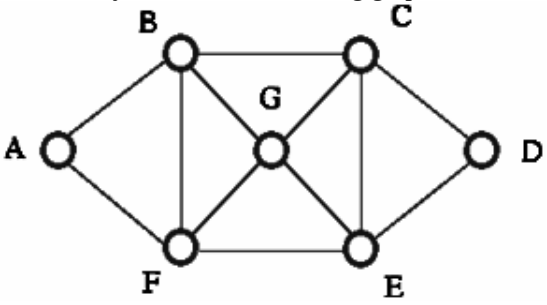
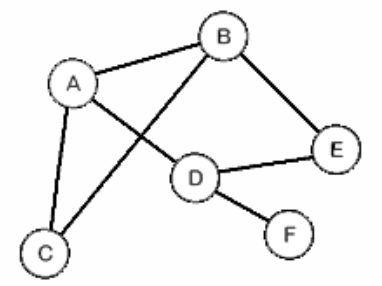
| S. No | Question | Blooms Taxonomy Level | Program Outcome |
|---|---|---|---|
| |   | | |
| 2 | **List** the articulation points from the following graph   | Understand | 5 |
| 3 | **Write** inorder, preoreder, post order traversal of the following tree   | Understand | 5 |
| 4 | **Apply** DFS and BFS traversals of following graph   | Understand | 5 |
| 5 | **Illustrate** DFS traversal of following graph   | Understand | 5 |
| 6 | **Apply** BFS traversal of following graph | Understand | 5 |

| S. No | Question | Blooms Taxonomy Level | Program Outcome |
|---|---|---|---|
| |  | | |
| 7 | **List** the articulation points from the following graph  | Understand | 5 |
| 8 | **Write** inorder, preorder, post order traversal of the following tree  | Understand | 5 |
| 9 | **Illustrate** BFS and DFS traversals of following graph  | Understand | 5 |
| 10 | **Apply** DFS traversal of following graph  | Understand | 5 |

| S. No | Question | Blooms Taxonomy Level | Program Outcome |
|---|---|---|---|
| | **UNIT-III** | | |
| | **PART – A (SHORT ANSWER QUESTIONS)** | | |
| 1 | **Define** greedy method | Knowledge | 8 |
| 2 | **What** is job sequencing with deadlines problem | Knowledge | 8 |
| 3 | **Define** minimum cost spanning tree | Knowledge | 8 |
| 4 | **State** the principle of optimality | Knowledge | 8 |
| 5 | **State** prims algorithm | Knowledge | 8 |
| 6 | **Explain** kruskals algorithm | Knowledge | 8 |
| 7 | **Define** single source shortest path problem | Knowledge | 8 |
| 8 | **What** is dynamic programming. | Knowledge | 8 |
| 9 | **List** the features of dynamic programming | Understand | 8 |
| 10 | **Distinguish** greedy method and dynamic programming | Analyze | 8,9 |
| | **PART – B (LONGANSWER QUESTIONS)** | | |
| 1 | **Explain** in detail job sequencing with deadlines problem with an example | Apply | 8 |
| 2 | **Discuss** single source shortest path problem with example | Apply | 8 |
| 3 | **Write** an algorithm knapsack problem .Give example | Apply | 8 |
| 4 | **Explain** prims algorithm with an example | Understand | 8 |
| 5 | **Discuss** kruskals algorithm with an example | Understand | 8 |
| 6 | **Explain** the concept multistage graphs with example. | Apply | 8 |
| 7 | **Write** an algorithm for optimal binary search tree Give example | Apply | 8 |
| 8 | **Explain** 0/1 knapsack problem with example | Understand | 8 |
| 9 | **Discuss** all pairs shortest path problem with an example | Understand | 8 |
| 10 | **Describe** the travelling salesman problem and discuss how to solve it using dynamic programming? | Understand | 9 |
| | **PART – C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)** | | |
| 1 | **Compute** the optimal solution for job sequencing with deadlines using greedy method. N=4, profits (p1,p2,p3,p4) = (100,10,15,27), Deadlines (d1,d2,d3,d4) = (2,1,2,1) | Apply | 8 |
| 2 | **Compute** the optimal solution for knapsack problem using greedy methodN=3, M= 20, (p1,p2,p3)= (25,24,15), (w1,w2,w3) =(18,15,10) | Apply | 8 |
| 3 | **Construct** minimum cost spanning tree using a) prims algorithm b) kruskal algorithm   | Apply | 8 |

| S. No | Question | Blooms Taxonomy Level | Program Outcome |
|---|---|---|---|
| 4 | **Apply** single source shortest path algorithm for the following graph   | Apply | 8 |
| 5 | **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 |
| 6 | **Construct** optimal binary search for (a1, a2, a3, a4) = (do, if,int, while), p(1 : 4) = (3,3,1,1) q(0 : 4)= (2,3,1,1,1) | Apply | 9 |
| 7 | **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 | 9 |
| 8 | **Solve** the solution for 0/1 knapsack problem using dynamic programming N=3 , m=6 profits (p1,p2,p3) = (1,2,5) weights (w1,w2,w3) = (2,3,4) | Apply | 9 |
| 9 | **Find** the shortest tour of traveling sales person for the following cost matrix using dynamic Programming $\begin{bmatrix} \infty & 12 & 5 & 7 \\ 11 & \infty & 13 & 6 \\ 4 & 9 & \infty & 18 \\ 10 & 3 & 2 & \infty \end{bmatrix}$ | Apply | 9 |
| 10 | **Calculate** shortest distances using all pairs shortest path algorithm   | Apply | 9 |
| | **UNIT-IV** | | |
| | **PART – A (SHORT ANSWER QUESTIONS)** | | |
| 1 | **State** the principle of Backtracking | Remember | 10 |
| 2 | **Write** control abstraction for backtracking | Apply | 10 |
| 3 | **List** the applications of backtracking? | Remember | 10 |

| S. No | Question | Blooms Taxonomy Level | Program Outcome |
|---|---|---|---|
| 4 | **Define** a dead node | Knowledge | 10 |
| 5 | **Differentiate** live node and dead node | Knowledge | 10 |
| 6 | **Define** state space tree | Knowledge | 10 |
| 7 | **What** do mean by solution space | Knowledge | 10 |
| 8 | **Define** solution states and answer state? | Knowledge | 10 |
| 9 | **Explain** 8 – Queens problem | Understand | 10 |
| 10 | **Define** Sum of Subsets problem | Understand | 10 |
| **PART – B (LONGANSWER QUESTIONS)** | | | |
| 1 | **Write** an algorithm for N-queens problem using backtracking | Apply | 11 |
| 2 | **Explain** subset-sum problem and discuss the possible solution strategies using backtracking. | Apply | 10 |
| 3 | **Describe** graph coloring problem and write an algorithm for m-coloring problem | Understand | 10 |
| 4 | **Write** an algorithm for Hamiltonian cycle with an example | Apply | 10 |
| 5 | **Explain** the properties of LC search | Apply | 11 |
| 6 | **Describe** control abstraction for LC Search | Understand | 11 |
| 7 | **Explain** the principle of FIFO branch and bound | Apply | 11 |
| 8 | **Discuss** principle of LIFO branch and bound | Apply | 11 |
| 9 | **Explain** the method of reduction to solve travelling sales person problem using branch and bound | Apply | 11 |
| 10 | **Solve** TSP using branch and bound method with example | Apply | 11 |
| **PART – C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)** | | | |
| 1 | **Sketch** the state space tree degenerated by 4 queens problem | Understand | 10 |
| 2 | **Apply** the backtracking algorithm to solve the following instance of the sum of subsets problem S={5,10,12,13,15,18} and d=30 | Apply | 10 |
| 3 | **Sketch** the state space tree generated all possible 3-color,4-node graph   | Apply | 10 |
| 4 | **Identify** Hamiltonian cycle from the following graph   | Understand | 10 |
| 5 | **Solve** the following instance of travelling sales person problem using Least Cost Branch Bound | Apply | 11 |

| S. No | Question | Blooms Taxonomy Level | Program Outcome |
|---|---|---|---|
| | $\begin{bmatrix} \infty & 12 & 5 & 7 \\ 11 & \infty & 13 & 6 \\ 4 & 9 & \infty & 18 \\ 10 & 3 & 2 & \infty \end{bmatrix}$ | | |
| 6 | **Draw** the portion of state space tree generated by LCBB by the following knapsack problem n=5 , (p1,p2,p3,p4,p5) =(10,15,6, 8, 4), (w1,w2,w3,w4,w5)=(4,6,3,4,2) and m=12 | Understand | 11 |
| 7 | **Draw** the portion of state space tree generated by FIFO knapsack for the instance N=4 , (P1, P2, P3, P4)= ( 10, 10, 12, 18 ) , ( w1, w2,w3,w4) = ( 2, 4, 6, 9 ) , m=15 | Understand | 11 |
| 8 | **Solve** the following instance of travelling sales person problem using Least Cost Branch Bound   | Apply | 11 |
| 9 | **Identify** Hamiltonian cycle from the following graph   | Understand | 10 |
| 10 | **Apply** the backtracking algorithm to color the following graph   | Understand | 10 |

## UNIT-V

### PART – A (SHORT ANSWER QUESTIONS)

| S. No | Question | Blooms Taxonomy Level | Program Outcome |
|---|---|---|---|
| 1 | **Define** class P | Knowledge | 12 |
| 2 | **Compare** NP-hard and NP-completeness | Knowledge | 12 |
| 3 | **Define** NP- hard problem | Knowledge | 12 |
| 4 | **What are** NP-complete problem | Knowledge | 12 |
| 5 | **Define** deterministic problem? | Knowledge | 12 |
| 6 | **Define** non-deterministic problem | Knowledge | 12 |
| 7 | **What is** a decision problem? | Knowledge | 12 |
| 8 | **Explain** optimization problem | Understand | 12 |
| 9 | **Define** maxclique problem? | Understand | 12 |
| 10 | **Define** halting problem | Knowledge | 12 |

### PART – B(LONG ANSWER QUESTIONS)

| | | | |
|---|---|---|---|
| 1 | **State** and prove cook's theorem | Apply | 12 |
| 2 | **Explain** deterministic and non-deterministic algorithms | Apply | 12 |
| 3 | **Write** non deterministic algorithm for sorting and searching | Understand | 12 |
| 4 | **Discuss about** non-deterministic knapsack algorithm | Apply | 12 |
| 5 | **Explain** how P and NP problems are related | Understand | 12 |
| 6 | **Distinguish** NP- hard and NP-complete problems | Understand | 12 |
| 7 | **Explain** decision problem with an example | Apply | 12 |
| 8 | **What is** chromatic number decision problem and clique decision problem | Apply | 12 |
| 9 | **Explain** the strategy to prove that a problem is NP-hard | Apply | 12 |
| 10 | **Discuss** various intractable problems give examples | Understand | 12 |

### PART – C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)

| | | | |
|---|---|---|---|
| 1 | **Show** that satisfiability is at most three literals reduces to chromatic number | Understand | 12 |
| 2 | **Prove** Hamiltonian cycle is in NP | Apply | 12 |
| 3 | **Prove** circuit-SAT is in NP | Apply | 12 |
| 4 | **List** two problems that have polynomial time algorithms justify your answer | Understand | 12 |
| 5 | **Explain** 3CNF satisfiability problem | Understand | 12 |
| 6 | **Discuss** P type problems with examples | Understand | 12 |

**HOD-CSE**