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# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal-500043, Hyderabad

B.Tech VI SEMESTER END EXAMINATIONS (REGULAR) - JULY 2023

Regulation: UG-20

DESIGN OF ALGORITHMS

Time: 3 Hours

(COMMON TO AE| ECE | EEE | ME | CE)

Max Marks: 70

Answer ALL questions in Module I and II

Answer ONE out of two questions in Modules III, IV and V

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

## MODULE – I

- Describe the binary search algorithm and its significance in searching sorted arrays. Provide the pseudo code for the binary search algorithm and analyze its time complexity.  
[BL: Understand| CO: 1|Marks: 7]
  - Consider an array of integers: [10, 7, 3, 8, 5, 2, 9, 1, 6, 4] Use the quick sort algorithm to sort the given array in ascending order. Show the step-by-step process of partitioning and sorting at each recursion step.  
[BL: Apply| CO: 1|Marks: 7]

## MODULE – II

- Summarize the depth-first search algorithm and its use in graph traversal. Discuss the order in which vertices are visited and the use of a stack or recursion in DFS. Provide an example graph and walk through the step-by-step process of DFS.  
[BL: Understand| CO: 2|Marks: 7]
  - Enumerate the concept of disjoint sets and the operations performed on them. Discuss how these operations are used to determine the connectivity and disjointness of elements in a set.

## MODULE – III

- Discuss about general method of dynamic programming. How does it break down complex problems into smaller overlapping subproblems and solve them in a bottom-up or top-down manner?  
[BL: Understand| CO: 3|Marks: 7]
  - You are a project manager and have a set of tasks that need to be completed. Each task has a specific deadline and a profit associated with it. However, you can only work on one task at a time. Your goal is to maximize the total profit by completing the tasks within their respective deadlines.

Task details:

Task 1: Deadline = 3, Profit = \$100

Task 2: Deadline = 1, Profit = \$50

Task 3: Deadline = 2, Profit = \$75

Task 4: Deadline = 4, Profit = \$120

Determine the optimal sequence of tasks to maximize the total profit while completing each task within its deadline. Find the maximum profit achievable and list the tasks included in the optimal sequence.  
[BL: Apply| CO: 3|Marks: 7]

4. (a) Discuss the single source shortest paths problem. How can dynamic programming be used to find the shortest paths from a single source vertex to all other vertices in a weighted graph?  
[BL: Understand| CO: 4|Marks: 7]
- (b) Consider a directed weighted graph with 4 vertices: A, B, C, and D. The graph has the following edges and weights:  
A → B: 5 units  
A → C: 3 units  
B → C: 2 units  
B → D: 6 units  
C → D: 7 units  
Task: Find the shortest paths between all pairs of vertices in the graph.  
[BL: Apply| CO: 4|Marks: 7]

#### MODULE – IV

5. (a) Describe in detail about graph coloring. How can backtracking be used to assign colors to the vertices of a graph such that no two adjacent vertices have the same color, using the minimum number of colors?  
[BL: Understand| CO: 5|Marks: 7]
- (b) Solve the sum of subsets problem for a given set of numbers {1, 3, 5, 7, 9}. Find all possible subsets whose elements sum up to a target value of 10.  
[BL: Apply| CO: 5|Marks: 7]
6. (a) Outline the concept of First In First Out (FIFO) Branch and Bound solution. How does it prioritize the exploration of subproblems based on their arrival time in the search queue?  
[BL: Understand| CO: 5|Marks: 7]
- (b) Implement the least cost branch and bound solution to solve the Traveling Salesperson problem for a given set of cities and their distance matrix. Find the shortest possible route that visits all cities exactly once and returns to the starting city.  
[BL: Remember| CO: 5|Marks: 7]

#### MODULE – V

7. (a) Explain Cook's theorem and its significance in computational complexity theory. What does it mean for a problem to be NP-complete?  
[BL: Understand| CO: 6|Marks: 7]
- (b) Non-deterministic algorithms allow for multiple possible paths or solutions. List the advantages and disadvantages of using non-deterministic algorithms compared to deterministic algorithms in solving computational problems.  
[BL: Analyze| CO: 6|Marks: 7]
8. (a) Mention the limitations and challenges associated with solving NP-hard problems. Are there any known strategies or techniques for mitigating these challenges? Elaborate.  
[BL: Understand| CO: 6|Marks: 7]
- (b) Explore the relationship between NP-hard problems and polynomial-time reductions. Discuss how polynomial-time reductions can be used to demonstrate the complexity of one problem in terms of another and provide an example to illustrate this concept.  
[BL: Understand| CO: 6|Marks: 7]

