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| Examination | : | End-Semester Examination – May/June 2025 |
| Name of the Course | : | B.Tech. (IT & Mathematical Innovations) |
| Name of the Paper | : | Analysis and Design of Algorithms |
| Unique Paper Code | : | 3122612402 |
| Semester | : | IV |
| Duration | : | 3 hours |
| Maximum Marks | : | 90 |

*Instruction to students:*

*Attempt any five questions out of seven. Question No. 1 is compulsory. All questions carry equal marks. Scientific calculators without storage memory are allowed.*

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Q.1 a) Considering the concept of growth of functions, give example of six varying growth functions and arrange them in order of fastest growing to slowest growing functions. (6*3)

b) Differentiate between branch & bound and backtracking approach for problem solving. Give one example of each.

c) Prove that $\sum_{i=1}^{n} log\ (i)$ is $\theta(n\ log\ n)$.

d) Solve $T(n) = T\left(\frac{9n}{10}\right) + n$ by master method.

e) Explain the difference between DFS and BFS with a suitable example.

f) Write the characteristics of dynamic programming and greedy approach for problem solving. Also mention their demerits, if any.

Q.2 a) What is a stable sorting method? Is merge sort a stable sorting method? Compare Merge sort with selection sort. (9+9)

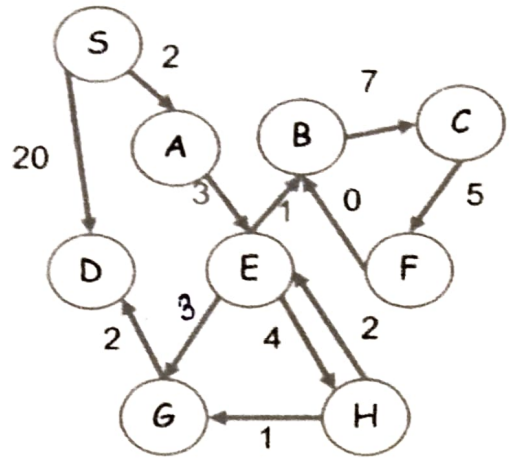
b) Trace the Quicksort algorithm to sort the list [C,O,L,L,E,G,E] in alphabetical order. Give an instance where the Quicksort algorithm has worst case complexity.

Q.3 a) Find the longest common subsequence of the strings x = [1,0,0,1,0,1,0,1] and y = [0,1,0,1,1,0,1,1,0] using dynamic programming. (9+9)

b) Determine the cost and structure of an optimal binary search tree for a set of **5** keys with following given probabilities.

| $i$ | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| $p_i$ | | 0.15 | 0.10 | 0.05 | 0.10 | 0.20 |
| $q_i$ | 0.05 | 0.10 | 0.05 | 0.05 | 0.05 | 0.10 |

Q.4 a) Use Dijkstra's algorithm on the given weighted directed graph. Take node 'S' as the starting vertex. Write all steps in detail. (9+9)




b) Use Floyd Warshall algorithm on the above given graph for determining all pair shortest path. Write all steps involved in detail.

Q.5 a) Let $S = \{a, b, c, d, e, f, g\}$ be a collection of objects with profits, weights as follows a: (12, 4), b: (10, 6), c: (8, 5), d: (11, 7), e: (14, 3), f: (7, 1), g: (9, 6). What is an optimal solution to the fractional knapsack problem for $S$ assuming we have a sack that can hold objects with total weight capacity of 18. Use greedy approach to formulate the solution. (9+9)

b) What is an optimal Huffman code for a set of frequencies based on first 8 Fibonacci numbers like a:1, b:1, c: 2, d: 3 . . . and so on.

Q.6 a) State and solve N-Queens problem using backtracking technique. Take N = 4, and draw entire state space tree for the solution. (9+9)

b) Explain Karatsuba's integer multiplication approach with a suitable example.

Q.7 Write short node on any three of the problems. (6*3)
a) Travelling salesman problem using backtracking.
b) N-P completeness
c) Rabin karp string matching algorithm
d) Merge Sort

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