



B.E. DEGREE EXAMINATIONS: NOV/DEC 2023

(Regulation 2018)

Fourth Semester

COMPUTER SCIENCE AND ENGINEERING

U18CST4001: Design and Analysis of Algorithms

COURSE OUTCOMES

- CO1:** Compare various graph traversal techniques.
CO2: Apply algorithm analysis techniques for a given algorithms.
CO3: Examine algorithm design techniques for a given application.
CO4: Analyze different algorithms for solving a given problem.
CO5: Develop application using chosen algorithm technique.

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)

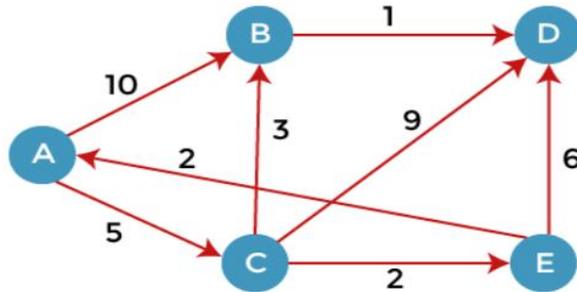
(Answer not more than 40 words)

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|--|-----|------|
| 1. Consider a weighted undirected graph G with n vertices and m edges. What is the time complexity of Kruskal's algorithm to find the minimum spanning tree of G? | CO1 | [K1] |
| 2. Define Breath First Search and Depth First Search. | CO1 | [K1] |
| 3. What are the two kinds of algorithm efficiency? | CO2 | [K1] |
| 4. Compare the order of growth of $\theta(n)$ and n^2 . | CO2 | [K2] |
| 5. Suppose you have an unsorted array of integers, and you want to find a specific value. Is it more efficient to use sequential search or binary search? Summarize your answer. | CO3 | [K2] |
| 6. How does Strassen's algorithm for matrix multiplication use the Divide and Conquer method? What is its time complexity? | CO3 | [K1] |
| 7. Compare the top-down and bottom-up approaches for dynamic programming and provide examples of each approach is preferred. | CO4 | [K2] |
| 8. What are some real-world applications of the Traveling Salesman Problem and the Optimal Binary Search Tree problem, and how can Dynamic Programming be applied to solve them? | CO4 | [K1] |
| 9. What is the N-Queens problem, and how can backtracking be used to solve it? | CO5 | [K1] |
| 10. What is P, NP, NP-complete problems? Can a problem be in NP but not NP-complete or NP-hard? | CO5 | [K1] |

**Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)**

11. a) Consider the following directed, weighted graph:

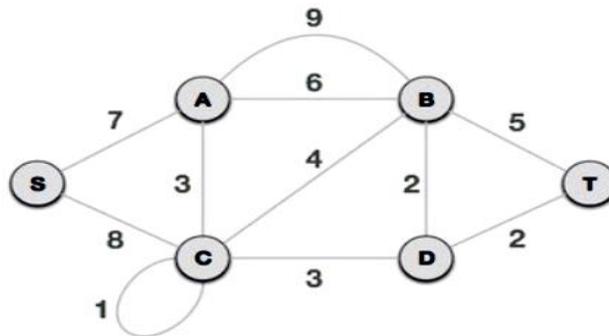
8 CO1 [K₃]



Step through Dijkstra's algorithm to calculate the single-source shortest paths from A to every other vertex. Show your steps in the table. Cross out old values and write in new ones, from left to right within each cell, as the algorithm proceeds. Also list the vertices in the order which you marked them known. Finally, evaluate the lowest-cost path from node A to node E.

b) Find the minimum shortest path using Prim's algorithm for the following graph and write a suitable algorithm for the same.

8 CO1 [K₃]



12. a) Solve The Following Recurrence Relation Using Recursion Tree Method.

12 CO2 [K₃]

$$T(n) = T(n/5) + T(4n/5) + n$$

b) Using substitution method, solve the following recurrence relation:

4 CO2 [K₃]

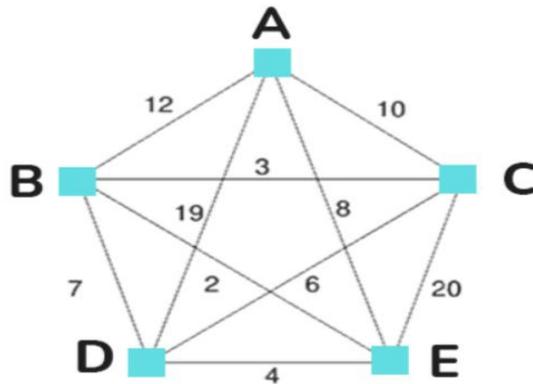
$$T(n) = 2 * T(\sqrt{n}) + 1 \text{ and } T(1) = 1$$

13. a) Compare and contrast the time complexity of sequential search algorithm with that of other string-matching algorithms, such as Knuth-Morris-Pratt

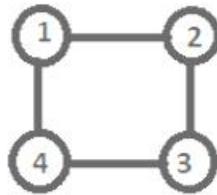
8 CO3 [K₂]

and Boyer-Moore algorithms. In what scenarios can sequential search algorithm be preferred over the other algorithms? Explain.

- b) Multiply 10110101 and 11101001 using Karatsuba algorithm and conclude with its pseudo code. 8 CO3 [K4]
14. a) Find the optimal solution for knapsack problem (fraction) where knapsack capacity = 28, $P = \{9, 5, 2, 7, 6, 16, 3\}$ and $w = \{2, 5, 6, 11, 1, 9, 1\}$, along with procedure. 8 CO4 [K1]
- b) Apply Travelling salesman algorithm on the following graph and summarize with algorithm. 8 CO4 [K3,2]



15. a) Solve 4-Queen problem using backtracking. 8 CO5 [K3]
- b) Colour the following graph using backtracking. Remember that no two adjacent nodes should be of same colour. You have 3 colours. 8 CO5 [K3]



16. a) What is the difference between FIFOBB and LIFOBB? Solve the Knapsack Problem using LIFOBB, assume knapsack capacity is $W = 8$. Show how stack is used for node creation in the state space tree using variable tuple representation 8 CO5 [K1,3]
- b) Solve the Job Sequencing Problem using FIFOBB. Select optimal subset J with an optimal penalty for the following data. What will be the penalty corresponding to the optimal solution? Discuss how queue is used in the state space tree using fixed tuple representation. 8 CO5 [K3,6]
