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**SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)**

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

**FIRST SEMESTER M.TECH DEGREE EXAMINATION (Regular), DECEMBER 2023****COMPUTER SCIENCE AND SYSTEMS ENGINEERING****(2021 Scheme)****Course Code: 21SE102****Course Name: Advanced Algorithmic Concepts****Max. Marks: 60****Duration: 3 Hours****PART A****(Answer all questions. Each question carries 3 marks)**

1. Draw the recurrence tree for  $T(n) = 4T(n/2) + cn$  where  $c$  is a constant & solve the recurrence.
2. Using aggregate method of amortized analysis; calculate the amortized cost of incrementing a Binary Counter.
3. Compute the prefix function  $\pi$  for the pattern "xyzxyxzxyz"
4. What are the operations possible on disjoint sets?
5. Define topological sorting. Write a recursive algorithm to perform topological sorting.
6. Define Matroids.
7. Explain MPM algorithm with the help of an example
8. What are the characteristics required by problems so that they can be solved by dynamic programming approach?

**PART B****(Answer one full question from each module, each question carries 6 marks)****MODULE I**

9. a) Explain the proof of master theorem (3)
- b) Using Masters Theorem, Solve the recurrence  $T(n) = 3T(n/3) + n^2$  (3)

**OR**

10. a) Solve the recurrence  $T(n) = 2T(n/2) + n$  using substitution method (3)
- b) Solve the recurrence  $T(n) = T(n/3) + n^{4/3}$  by iteration method (3)

**MODULE II**

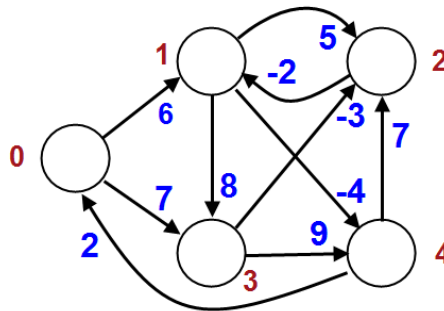
11. a) Give the different cases involved in the insertion operation in a Red Black tree with example (2)
- b) Insert 2,1,4,5,9,3,6,7 into an initially empty Red Black tree (4)

**OR**

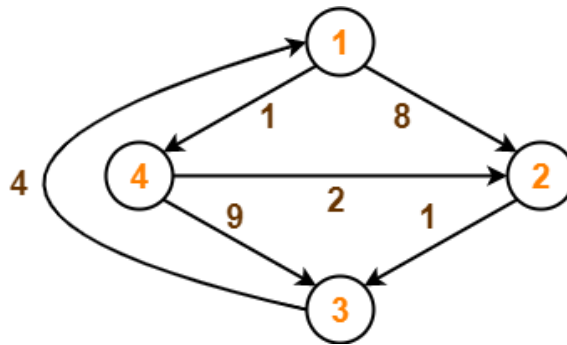
12. a) Demonstrate the Binomial heap union operation showing all possible cases & algorithm. (3)  
 b) Explain Rabin-Karp algorithm? Illustrate the Rabin Karp algorithm for the text : 3141592653589793 Pattern: 589 assign  $q=7$  (3)

**MODULE III**

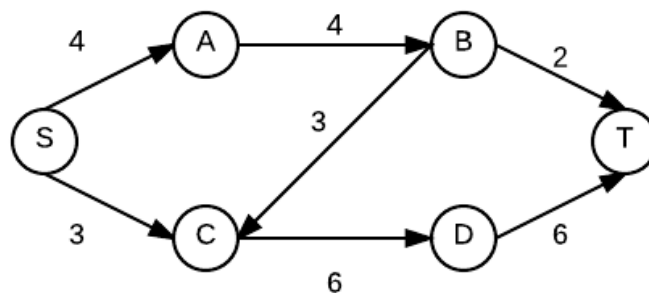
13. a) Is the minimum spanning tree of a graph be unique? Justify) (3)  
 b) Apply Bellman Ford Algorithm on the graph. Assume 0 as source vertex. (3)

**OR**

14. a) Can we use DFS to detect cycles in a graph? Justify. (3)  
 b) Apply Floyd Warshall Algorithm on the graph given below. (3)

**MODULE IV**

15. Show the execution of Ford Fulkerson Flow algorithm. Find the minimum cut and the maximum flow across the cut . Also find the capacity of the cut. (6)



**OR**

16. Prove that “If the Edmond’s Karp Algorithm is run on a flow network  $G=(V,E)$  with source  $s$  and sink  $t$ , then the total number of flow augmentation performed by the algorithm is  $O(VE)$ ”. (6)

**MODULE V**

17. Prove that Matroids exhibit optimal substructure property & greedy choice property. (6)

**OR**

18. What is greedy strategy? Also explain optimal substructure property and greedy choice property. (6)

**MODULE VI**

19. Prove that Satisfiability of Boolean formulas in 3-CNF is NP Complete. (6)

**OR**

20. Prove that the Graph Coloring problem is NP Complete. (6)

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