MCS-031

MCA (Revised)

Term-End Examination

December, 2021

MCS-031 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 hours *Maximum Marks : 100*

Note : *Question no.* ***1*** *is* ***compulsory****. Attempt any* ***three*** *questions from the rest.*

1. (a) Explain Principle of Optimality with the help of an example. *5*

(b) Enumerate any five well-known techniques for designing algorithms for solving problems. *5*

(c) Define Big-O (Oh) Asymptotic Notation. Also arrange the following growth rates in an increasing order : *5*

$O(n^3)$, $O(3^n)$, O(n log n), O(1), O(log n)

(d) Explain Vertex Cover Problem (VCP) with suitable example. *5*

(e) Prove that the run time complexity of binary search algorithm in worst case is $O(\log_2 n)$. *5*

(f) Write the limitations of Strassen's Matrix Multiplication algorithm. Also show that the running time of this algorithm is $O(n^{2.81})$. *10*

(g) Solve the following Recurrence Relation : *5*

$$t_n - t_{n-1} - t_{n-2} = 0, \quad t_0 = 0 \text{ and } t_1 = 1$$

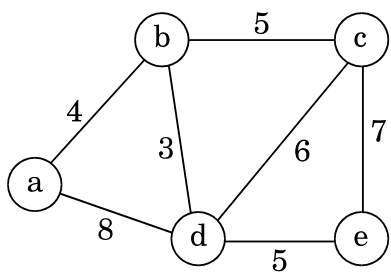
2. (a) Compare Kruskal's algorithm and Prim's algorithm. Determine the time complexity of Kruskal's algorithm. *10*

(b) Sort the given list using Quicksort and show the steps involved in the process :

90, 100, 30, 20, 5, 80, 40

Show that the best case time complexity of Quicksort is $O(n \log_2 n)$. *10*

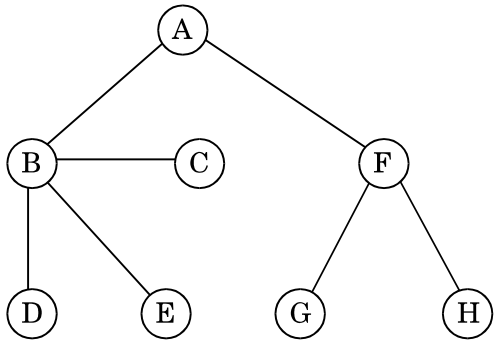
3. (a) Write Dijkstra's algorithm to find Single-Source Shortest Path. Apply the algorithm to find shortest path from starting vertex 'a'. *10*



(b) Define P, NP, NP complete and NP hard problems with suitable examples. *10*

4. (a) Explain Push Down Automata with an example. How is it different from Finite Automata ? Discuss with suitable example. *10*

(b) Write DFS algorithm and traverse the following tree with starting node as A. *10*



5. (a) Explain ambiguity in Context-Free Grammar (CFG). Show that $E \rightarrow E + E \mid E * E \mid id$ is ambiguous. *5*

(b) Describe Chomsky classification of Grammars. *5*

(c) Write short notes on the following : $4 \times 2\frac{1}{2} = 10$

(i) Halting Problem of Turing Machine

(ii) 0/1 Knapsack Problem

(iii) Satisfiability Problem

(iv) Clique Problem