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BCS–042

BACHELOR OF COMPUTER APPLICATIONS

(BCA)

Term-End Examination

June, 2025

BCS-042 : INTRODUCTION TO ALGORITHM DESIGN

Time : 2 Hours *Maximum Marks : 50*

Note : *Question No.* ***1*** *is compulsory and carries 20 marks. Answer any* ***three*** *questions from the rest.*

1. (a) Define the term 'algorithm' and explain its importance in Computer Science. Discuss the concept of recursion and provide and example of recursive algorithm. 5

   (b) What is the time complexity of linear search algorithm ? Explain with the help of an example. 5

   (c) Describe any *three* of the following : 3×2=6

   (i) Backtracking

   (ii) Fractional Knapsack problem

   (iii) Connected graph

   (iv) Euclid Algorithm for GCD

(d) Suppose you are given currency notes of the following denominations :

(2, 5, 10, 15, 20, 100, 500)

Further it is assumed that currency notes of each denomination are available in sufficient numbers for purpose of using the minimum number of notes. The problem is to find minimum number of notes to make an amount of ₹ 437. Using greedy approach, show sequence of steps for selection of notes to make ₹ 437. 4

2. (a) Solve the recurrence : 5

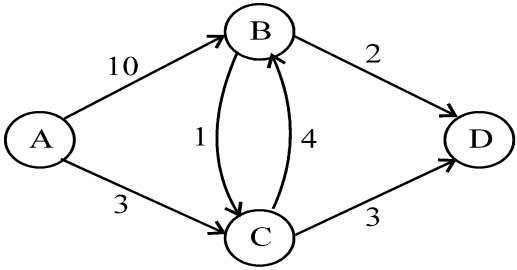
$$T(n) = T\left(\left\lfloor \frac{n}{3} \right\rfloor\right) + T\left(\left\lfloor \frac{2n}{3} \right\rfloor\right) + n$$

using recursion tree method.

(b) The recurrence $T(n) = 7T\left(\frac{n}{2}\right) + n^2$ describes the runtime of an algorithm. A competing algorithm A′ has running time of $T'(n) = aT\left(\frac{n}{4}\right) + n^2$. What is the largest integer value for $|a|$ such that |A′| is asymptotically faster than A ? 5

3. (a) Given an array of size(n), analyze the time complexity of the bubble sort algorithm. If array is already sorted in ascending order, what would be the best time complexity ? Provide the Big-O notation for both the best case and worst case scenarios. 5

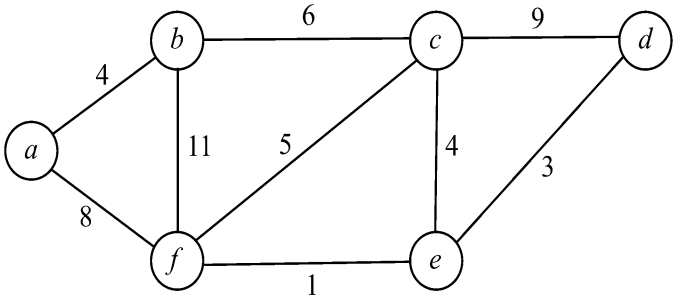
(b) Apply the Dijkstra's algorithm to find the shortest path from Vertex A to each of the other vertices for the following directed graph : 5



4. (a) Compare and contrast Depth-First Search (DFS) and Breadth First Search (BFS) algorithms. Highlight their similarities and differences and discuss their respective use cases. 5

(b) Is the minimum spanning tree of any graph unique ? Apply Prim's algorithm

to find a minimum cost spanning tree for the following graph ('*a*' is the starting vertex) : 5



5. (a) Show that the runtime of partition procedure of quick sort algorithm on a sub-array of size (n) is $\theta(n)$. 5

(b) Explain the divide and conquer approach of matrix multiplication of two 4×4 matrices. 5

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