विश्वजीवनामृतं ज्ञानम्

ABV- Indian Institute of Information Technology & Management, Gwalior

Design and Analysis of Algorithms (IT203)

Major Examination (Session 2024–25)

Maximum Time: 3 Hours **Max Marks: 70**

Note: Attempt all questions. All questions carry equal marks.

1. (a) Define asymptotic notations Big-O, Big-, and Big- with proper mathematical definitions. (b) Arrange the following functions in increasing order of growth: $f_1(n) = n \log n$, $f_2(n) = 2^n$, $f_3(n) = n^3$, $f_4(n) = \sqrt{n}$, $f_5(n) = n!$ Justify your answer. (10 Marks)

2. Solve the following recurrence relations using an appropriate method: (a) $T(n) = T(n/2) + \log n$ (b) $T(n) = 4T(n/2) + n^2$ (c) $T(n) = T(n-1) + n$ (10 Marks)

3. (a) Write and explain the algorithm for Merge Sort. Prove its time complexity. (b) Apply Merge Sort on the array {38, 27, 43, 3, 9, 82, 10} and show all steps. (10 Marks)

4. (a) What is a Greedy Algorithm? Give two real-world problems where greedy strategy is applicable. (b) Solve the following using Greedy approach: Activity Selection Problem with activities and finish times – {(1,3), (2,5), (4,6), (6,7), (5,8), (8,9)} (10 Marks)

5. (a) Define Dynamic Programming. How does it differ from Divide and Conquer? (b) Solve the following using DP: Find the minimum number of scalar multiplications needed for matrix chain multiplication of dimensions {10×20, 20×30, 30×40, 40×30}. (10 Marks)

6. (a) Define NP, NP-Hard and NP-Complete problems with examples. (b) Show that the Clique Problem is NP-Complete by reduction from the Vertex Cover or 3-SAT problem. (outline proof) (10 Marks)

7. Write short notes on any two: (i) Graph representation techniques (Adjacency Matrix vs List). (ii) Huffman Coding and its correctness proof. (iii) Applications of shortest path algorithms in networks. (10 Marks)