3 (Sem–4/CBCS) CSC HC 1

2024

COMPUTER SCIENCE

(Honours Core)

Paper : CSC–HC–4016

(Design and Analysis of Algorithms)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : (by choosing the correct options) 1×7=7

   (i) The highest lower bound on the number of comparisons, in the worst-case, for comparison based algorithms is the order of :

   (a) n

   (b) n^2

   (c) $n \log n^2$

   (d) $n \log_2 n$

(ii) The most appropriate matching for the following pairs—

(X) depth first search	(1) Heap
(Y) breadth first search	(2) Queue
(Z) sorting	(3) Stack

is :

(a) X–1, Y–2, Z–3

(b) X–3, Y–1, Z–2

(c) X–3, Y–2, Z–1

(d) X–2, Y–3, Z–1

(iii) The correct matching for the following pair—

(A) All pairs shortest paths	(1) Greedy Algorithm
(B) Quick sort	(2) DFS
(C) Minimum weight spanning tree	(3) Dynamic programming
(D) Connected components	(4) Divide or conquer

is :

(a) A–2, B–4, C–1, D–4

(b) A–3, B–4, C–1, D–2

(c) A–3, B–4, C–2, D–1

(d) A–4, B–1, C–2, D–3

(iv) Big-oh notation expresses the upper bound of a _____'s running time.

(a) Program

(b) Flowchart

(c) Algorithm

(d) Function

(Fill up the blank with correct option)

(v) Kruskal's algorithm uses _____ and Prim's algorithm uses _____ in determining the MST (Minimum Spanning Tree).

(a) edges, vertex

(b) vertex, edges

(c) edges, edges

(d) vertex, vertex

(Fill up the blanks with correct options)

(vi) The root of Red-Black tree is :

(a) Red

(b) Black

(c) Red *or* Black

(d) Both Red and Black

Contd.

(vii) A characteristic of the data that Binary search uses, but the linear search ignores, is the :

(a) order of the list

(b) length of the list

(c) maximum value of the list

(d) mean value of the list

2. Answer the following questions : 2×4=8

(a) Name *two* problems which can be solved using dynamic programming.

(b) Why do we consider that the counting sort Algorithm is stable ? Write the reason.

(c) Why is Red-Black tree said to be a self-balancing tree ?

(d) What do you mean by KMP Technique ?

3. Answer ***any three*** of the following questions : 5×3=15

(a) Write *any three* reasons for studying the space complexity, and *any two* reasons for studying the time-complexity of an algorithm.

(b) Write the *two* properties that are shown by a problem, when a Greedy Algorithm works fine/good.

(c) Briefly explain the working principle of Bucket sort.

(d) Write the *three* major phases of the 'divide-and-conquer' paradigm.

(e) Name *five* different Algorithms that are used for string matching implementation with the worst-case notation for each of them.

4. Answer ***any three*** of the following questions : 10×3=30

(a) Write *five* characteristics that are common to all Dynamic programming problems. Mention *any five* differences between Dive and Conquer and Dynamic programming. 5+5=10

(b) Explain the working principle of Radix Sort. Illustrate column-wise operation to get the sorted output of the RADIX-SORT on the given array elements : 329, 457, 657, 839, 436, 720, 355 5+5=10

(c) Describe the working of Counting Sort Algorithm with the help of an example.

(d) What do you mean by Left rotation and Right rotation operations of the Red-Black tree ? Write Algorithms for Left rotation (T, x) and Right rotation (T, y).

(e) Write either the procedure or an Algorithm for Depth-First Search (DFS) that works on Graphs.

(f) Write *any one* Algorithm to determine the Minimum Spanning tree of a Graph. Also explain briefly the main idea behind that Algorithm.
