



**MAULANA ABUL KALAM AZAD UNIVERSITY OF
TECHNOLOGY, WEST BENGAL**

Paper Code : IT-501

DESIGN AND ANALYSIS OF ALGORITHMS

Time Allowed: 3 Hours

Full Marks: 70

*The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words
as far as practicable.*

Group – A

(Multiple Choice Type Questions)

I. Choose the correct alternative for each of the followings:

1×10=10

- (i) Single source shortest path in a graph having negative edge can be solved by
 - (a) Greedy method
 - ☒ (b) Greedy method and Dynamic programming
 - (c) Dynamic programming only
 - (d) None of the above
- (ii) A matrix chain having 5 matrices can be parenthesized in
 - (a) 14 different combinations
 - ☒ (b) 15 different combinations
 - (c) 13 different combinations
 - (d) None of the above
- (iii) The worst-case time complexity of Merge Sort is _____.
 - (a) $O(n^2)$
 - (b) $O(\log n)$
 - (c) $O(n)$
 - ☒ (d) $O(n \log n)$

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- (iv) Which of the following sorting procedures is the slowest?
- (a) Quick sort
 - (b) Heap sort
 - (c) Shell sort
 - ☒ (d) Bubble sort
- (v) A list of n strings, each of length n , is sorted lexicographic order using the merge-sort algorithm. The worst case running time of this computation is
- ☒ (a) $O(n \log n)$
 - (b) $O(n^2 \log n)$
 - (c) $O(n^2 + \log n)$
 - (d) $O(n^2)$
- (vi) The space factor determining the efficiency of algorithm is measured by
- ☒ (a) counting the maximum memory needed by the algorithm
 - (b) counting the minimum memory needed by the algorithm
 - (c) counting the average memory needed by the algorithm
 - (d) counting the maximum disk space needed by the algorithm
- (vii) The computing time of Job Sequencing problem can be reduced from $O(n^2)$ to $O(n)$ by using
- (a) backtracking algorithm
 - ☒ (b) branch and bound algorithm
 - (c) disjoint set union and find algorithms
 - (d) divide and conquer algorithm
- (viii) The main different between Dynamic programming and Greedy algorithm is
- ☒ (a) in Greedy algorithm many decision sequences may be generated but in Dynamic Programming only one decision is ever generated.
 - (b) in Greedy algorithm only one decision is ever generated but in Dynamic Programming many decision sequences may be generated.
 - (c) Greedy method always gives optimal solution but in Dynamic Programming optimal solution may not be obtained.
 - (d) None of the above
- (ix) The nondeterministic time complexity of searching problem is
- (a) $O(n \log_2 n)$
 - (b) $O(n^2)$
 - (c) $O(\log_2 n)$
 - ☒ (d) $O(1)$

(x) Time complexity of the recurrence relation $T(n) = \begin{cases} 2T\left(\frac{n}{2}\right) + n, n \geq 2 \\ \text{constant}, n = 1 \end{cases}$ will be

- (a) $O(\log_2 n)$
- (b) $O(n \log_2 n)$
- (c) $O(n^2)$
- (d) $O(n)$

Group – B

(Short Answer Type Questions)

Answer any three of the following.

2. Explain satisfiability problem and Cook's theorem. 5
3. Write an algorithm for Graph Coloring Problem. What is the time complexity of your algorithm? 4+1=5
4. Derive the worst case time complexity of merge sort. http://www.makaut.com 5
5. Write an algorithm to insert an element into a heap. What is the complexity of your algorithm and why? 3+2=5
6. Write a recursive algorithm for finding maximum and minimum from a list of elements. Also find the complexity of your algorithm. 3+2=5

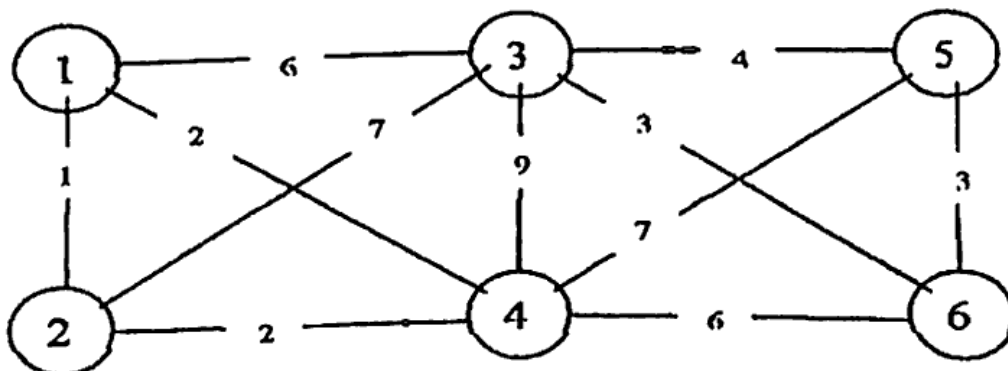
Group – C

(Long Answer Type Questions)

Answer any three of the following.

15×3=45

7. Differentiate between Prim's and Kruskal's algorithm. Write an algorithm for "Weighted Union". Find the minimum cost spanning tree using Prim's algorithm for the graph given below. Explain the complexity of Prim's and Kruskal algorithm.



3+2+3+7=15

8. (a) Discuss the procedure for Strassen's matrix multiplication to evaluate the product of n matrices. Find the resulting recurrence relation for the same and analyze its time complexity. Justify that this method is an improvement over the conventional matrix multiplication method.
(b) How can you find a solution of simultaneous linear equation using LUP decomposition?
 $7+1+2+2+3=15$
9. (a) Using Knuth Morris Pratt algorithm, find whether the pattern $P = \{0\ 0\ 1\ 0\}$, is in the text $T = \{1\ 1\ 0\ 0\ 0\ 1\ 1\ 0\ 1\ 0\ 0\ 0\ 1\ 0\ 1\ 0\}$ or not.
(b) A sequence of n operations is performed on a data structure. The i th operation costs 1 if i is an exact power of 2, and 1 otherwise. use an accounting method and potential method to determine the amortized cost per operation.
 $5+4+6=15$
10. (a) Write and explain the classes of P, NP, NP-hard and NP-Complete.
(b) What is reducibility?
(c) Write down the algorithm of nondeterministic sorting.
(d) "If any NP complete problem can be solved in polynomial time then $P = NP$ " — Discuss.
 $5+2+4+4=15$
11. Write short notes *any three* of the following:
 $5 \times 3 = 15$
(a) Union-Find Algorithm & Union by Rank
(b) TSP using Approximations Algorithm *travelling salesman prob.*
(c) Asymptotic notation
(d) Vertex Cover Problem
(e) Ford Fulkerson Algorithm

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