MCA – 4
ADA

Set - 2

Full Marks : 70

Time : 3 hours

Answer Q. No. 1 which is compulsory and any five questions from the rest.

The figures in the right-hand margin indicate marks.

1. Answer all questions: [2 x 10]

(i) $F(n) = n^3 + n \log n$, then find O(F(n)).

(ii) $f(n) = n^3$, $g(n) = n^2$, then find O(fg(n)).

(iii) $T(n) = 7T(n/3) + n^2$, then find O(T(n)).

(iv) $T(n) = 2T(n/4) + \sqrt{n}$, then find O(T(n)).

(v) What is graph coloring problem? Give an example.

(vi) What is a flow network? What is skew symmetry property?

(vii) Construct a max heap tree with the data {C, O, M, P, U, T, E, R}.

(viii) What is memoization? How is it different from dynamic programming?

(ix) What is the basic difference between NP-hard and NP-complete problems?

(x) What do you mean by the convex hull of a given set of points? Give a suitable example.

2. (a) Differentiate between aggregate analysis and potential method of amortized analysis with suitable examples. [5]

(b) What are randomized algorithms? Explain the use of indicator random variables in randomized algorithms with a suitable example. [5]

3. (a) Explain the divide-and-conquer technique of analyzing algorithms taking merge sort as an example and derive its worst-case running time. [5]

(b) What are the elements of dynamic programming? Determine a longest common subsequence of < 1, 0, 0, 1, 0, 1, 0, 1 > and < 0, 1, 0, 1, 1, 0, 1, 1, 0 > using dynamic programming and show the table entries. [5]

→ fractional knapsack
(1, 1, 1, 1, 1, 1, 0.333), $\sum w_i x_i = 24$, $\sum p_i x_i = 62$.
0/1 knapsack → (1, 1, 1, 1, 1, 1, 0), $\sum w_i x_i = 22$, $\sum p_i x_i = 61$.

4. (a) Find an optimal solution to the Knapsack instance n = 7, m = 24, w = { 2, 3, 5, 7, 1, 4, 6 } and P = { 10, 5, 15, 7, 6, 18, 3 }. [5]

(b) Explain why 0 / 1 Knapsack problem cannot be solved optimally using greedy method with a suitable example. [5]

5. (a) Explain the backtracking technique of analyzing algorithms with a suitable example. [5]

(b) Discuss Prim's algorithm to find the spanning tree of a given graph with a suitable example. [5]

6. (a) What is the basic difference between P, NP and NP-complete problems ? Prove that the circuit-satisfiability problem belongs to the class NP. [5]

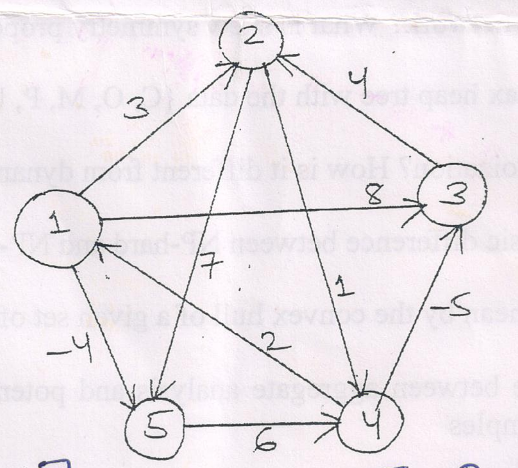
(b) Explain the Rabin-Karp string matching algorithm with a suitable example. [5]

7. (a) Explain how the vertex-cover problem can be solved using an approximation algorithm. [5]

(b) Discuss Graham's algorithm to find the convex hull of a given set of points. [5]

8. (a) Explain TVSP problem with a suitable example. [5]

(b) Run the Floyd-Warshall algorithm on the following weighted, directed graph and find the shortest path between each pair of vertices. Show the matrix $D^{(k)}$ that results from each iteration. [5]



$D^{(4)} =$

0	3	-1	4	-4
3	0	-4	1	-1
7	4	0	5	3
2	-1	-5	0	-2
8	5	1	6	0

$D^{(5)} =$

0	1	-3	2	-4
3	0	-4	1	-1
7	4	0	5	3
2	-1	-5	0	-2
8	5	1	6	0

$D^{(0)} =$

0	3	8	∞	-4
∞	0	∞	1	7
∞	4	0	∞	∞
2	∞	-5	0	∞
∞	∞	∞	6	0

$D^{(1)} =$

0	3	8	∞	-4
∞	0	∞	1	7
∞	4	0	∞	∞
2	5	-5	0	-2
∞	∞	∞	6	0

$D^{(2)} =$

0	3	8	4	-4
∞	0	∞	1	7
∞	4	0	5	11
2	5	-5	0	-2
∞	∞	∞	6	0

$D^{(3)} =$

0	3	8	4	-4
∞	0	∞	1	7
∞	4	0	5	11
2	-1	-5	0	-2
∞	∞	∞	6	0