DESIGN & ANALYSIS OF ALGORITHMS
(INFO 3103)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) Given an array arr = {45,77,89,90,94,99,100} and key = 100; What are the mid values(corresponding array elements) generated in the first and second iterations?
(a) 90 and 99 (b) 90 and 100
(c) 89 and 94 (d) 94 and 99.

(ii) How many solution/solutions are available for a graph having negative weight cycle?
(a) One solution (b) Two solutions
(c) No solution (d) Infinite solutions.

(iii) In what time can a binary heap be built?
(a) O(N) (b) O(N log N)
(c) O(log N) (d) $O(N^2)$.

(iv) How many times the for loop in the Bellmann Ford Algorithm gets executed?
(a) V times (b) V-1
(c) E (d) E-1.

(v) How many sub arrays does the quick sort algorithm divide the entire array into?
(a) one (b) two
(c) three (d) four.

(vi) A person wants to visit some places. He starts from a vertex and then wants to visit every vertex till it finishes from one vertex, backtracks and then explore other vertex from same vertex. What algorithm he should use?
(a) Depth First Search (b) Breadth First Search
(c) Trim's algorithm (d) Kruskal's Algorithm.

(vii) What happens when the value of k is 0 in the Floyd Warshall Algorithm?
(a) 1 intermediate vertex (b) 0 intermediate vertex
(c) N intermediate vertices (d) N-1 intermediate vertices

(viii) Choose the correct statement from the following.
(a) branch and bound is more efficient than backtracking
(b) branch and bound is not suitable where a greedy algorithm is not applicable
(c) branch and bound divides a problem into at least 2 new restricted sub problems
(d) backtracking divides a problem into at least 2 new restricted sub problems.

(ix) Solve the following recurrence using Master's theorem $T(n) = 16T(n/4) + n$.
(a) $T(n) = O(n)$ (b) $T(n) = O(\log n)$
(c) $T(n) = O(n^2 \log n)$ (d) $T(n) = O(n^2)$.

(x) Backtracking algorithm is implemented by constructing a tree of choices called as?
(a) State-space tree (b) State-chart tree
(c) Node tree (d) Backtracking tree.

Group – B

2. (a) Explain the different properties of algorithm.

(b) Using Recursion Tree calculate the time complexity of the recurrence relation $T(n) = 9T(n/3) + n$.

(c) Solve the following recurrence relation using master theorem
(i) $T(n) = 3T(n/4) + n^2$
(ii) $T(n) = 4T(3n/4) + 5$
(iii) $T(n) = 3T(n/3) + n \log n$.

2 + 4 + (3 × 2) = 12

3. (a) Write an algorithm of Heap sort and deduce it's time complexity.

(b) (i) Construct a min heap of the following input list 75 65 35 5 25 85 45 55
(ii) delete node 25 from heap
(iii) insert node 15 into heap

5 + (3 + 2 + 2) = 12

Group – C

4. (a) Write down the algorithm for doing backtracking from a given node n.

(b) Write short notes of the following
(i) Residual networks
(ii) Augmenting path
(iii) Max-flow min-cuts theorem.

(c) Deduce the time complexity of n queens problem.

4 + (3 × 2) + 2 = 12

5. (a) Write an algorithm of BFS which can traverse all the nodes of the digraph.

   (b) Explain graph colouring problem using state space tree.

6 + 6 = 12

Group – D

6. (a) Find out minimum spanning tree using Prims' of the following graph (adjacency matrix given). Show step by step solution using min heap. Consider node A as a first node.

i/j	A	B	C	D	E
A	0	4	2	1	0
B	4	0	5	0	4
C	2	5	0	4	4
D	1	0	4	0	2
E	0	4	4	2	0

   (b) Find an optimal parenthesization of a matrix-chain product whose sequence of dimensions is {25, 15, 30, 20, 5}.

4 + 8 = 12

7. (a) State the knapsack problem using greedy method

   (b) Find out all possible feasible solutions including optimal one of the knapsack problem using greedy method where n=5; m=35; (p1, p2, p3, p4, p5)=(24, 30, 20, 15, 40) and (w1, w2, w3, w4, w5)=(10, 12, 6, 4, 21).

   (c) Explain with an example how negative edge cycle can be detected by Bellman-Ford algorithm?

2 + 6+ 4 = 12

Group – E

8. (a) What is the difference between deterministic and non deterministic algorithm?

   (b) Write a non deterministic algorithm to search an element X on A[1:n] where n>=1.

   (c) Let A[i], 1<= i <= n, be an unsorted array of positive integers. Write a nondeterministic algorithm to sort the numbers into increasing order.

3 + 4 + 5 = 12

9. (a) Describe circuit satisfiability problem.

   (b) Prove that CDP(Clique Decision Problem) is NP-complete.

5 + 7 = 12

Department & Section	Submission Link
IT	https://classroom.google.com/c/MTIzNjQ0NzAzMzc3/a/MjY0OTA3NTE5OTI4/details