(b) What is an articulation point? Given an undirected connected graph G, explain how to find all articulation points in it.

(4 + 4) + (1 + 3) = 12

7. (a) What is the chromatic number of a graph? Explain the problem of m-colouring of a graph?

(b) What is a planar graph? Write an algorithm to solve m-colourability decision problem.

(3 + 3) + (2 + 4) = 12

Group – E

8. (a) Discuss diagrammatically the relations among P, NP, NP hard and NP complete classes.

(b) What is Vertex Cover (Or Node Cover) in Graph Theory? Prove that the vertex cover problem (VCP) is NP-Complete.

4 + (2 + 6) = 12

9. (a) What is branch and bound technique? Explain with proper example how it is different from Backtracking.

(b) Applying least-cost Branch and Bound method find the solution of the 0/1 Knapsack Problem with profit vector (10, 10, 12, 18) the weight vector (2, 4, 6, 9) and a knapsack of capacity 15.

(c) What is Manhattan cost? Explain in terms of a 15-Puzzle grid.

(2 + 3) + 4 + 3 = 12

DESIGN AND ANALYSIS OF ALGORITHMS
(MCAP 2101)

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) Let W(n) and A(n) denote respectively, the worst case and average case running time of an algorithm executed on an input of size n. Which of the following is always true?
(a) $A(n) = \Omega(W(n))$ (b) $A(n) = \Omega(W(n))$
(c) $A(n) = \Theta(W(n))$ (d) $A(n) = O(W(n))$.

(ii) Worst case time complexity of Prim's algorithm is (where n is the number of vertices)
(a) $O(n \log n)$ (b) $O(n^2)$
(c) $O(\log n)$ (d) $O(n)$.

(iii) The node removal of which makes a graph disconnected is called
(a) Pendant vertex (b) Bridge
(c) Articulation point (d) Coloured vertex.

(iv) The time factor when determining the efficiency of an algorithm is measured by
(a) Counting microseconds
(b) Counting the number of key operations
(c) Counting the number of statements
(d) Counting the kilobyte of algorithm

(v) A sorting technique is called stable if
(a) it takes $O(n \log n)$ time
(b) it takes $O(n \log n)$ space
(c) it maintains the relative order of occurrence of non-distinct elements
(d) it does not maintain the relative order of occurrence of non-distinct elements.

(vi) In Knuth-Morris-Pratt pattern matching, the failure function for the pattern *abaa* is
(a) 0 1 1 1 (b) 1 0 1 2
(c) 0 0 1 2 (d) 0 0 1 1.

(vii) Which of the following technique is not used for solving a 0-1 knapsack problem?
(a) Greedy (b) Dynamic programming
(c) Branch and bound (d) Backtracking.

(viii) Breadth-First-Search on a graph G = (V, E) has running time
(a) O (|V| + |E|) (b) O (|V|)
(c) O (|E|) (d) none of (a), (b) and (c).

(ix) In which sorting technique, an element is placed in its proper position at each step?
(a) Bubblesort (b) Quicksort
(c) Mergesort (d) Heapsort.

(x) Time complexity of non-deterministic algorithm is always
(a) less than deterministic algorithm
(b) greater than deterministic algorithm
(c) equal to deterministic algorithm
(d) none of (a), (b) and (c).

Group – B

2. (a) Discuss the procedure for Strassen's matrix multiplication to evaluate the product of two matrixes. Find the resulting recurrence relation for the same and analyse it's time complexity. Is there any improvement in time complexity over the conventional multiplication? If so, describe.

(b) Differentiate between divide–and-conquer method and dynamic programming method.

(5+1+2+2) + 2 = 12

3. (a) Define different types of asymptotic notations (O, θ, Ω) with suitable diagrams and example. Show that $10n^2 + 7 \neq O(n^2)$.

(b) State the pseudo code for merge-sort algorithm and show that the average case running time complexity is O (n $\log_2$ n).

(2 + 2 + 3) + 5 = 12

Group – C

4. (a) Write an algorithm to solve 0/1 knapsack problem using dynamic programming.

(b) Given the profit vector (1, 2, 5) and the weight vector (2, 3, 4) and a knapsack of capacity 6, find an optimal solution for the 0/1 knapsack problem using dynamic programming.

4 + 8 = 12

5. (a) Find all pair shortest paths in the given graph represented in Fig. 1 using Floyd-Warshall algorithm.

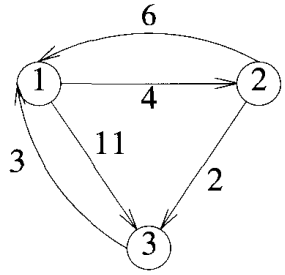

Fig. 1

(b) Let us consider a set of given jobs as shown in the following Table 1 associated with its individual deadline and profit values. Find a sequence of jobs, which will be completed within their deadlines and calculate the maximum profit.

Job	$J1$	$J2$	$J3$	$J4$	$J5$
Deadline	2	1	3	2	1
Profit	60	100	20	40	20

Table 1

6 + 6 = 12

Group – D

6. (a) For the graphs given in Fig. 2 and Fig. 3 respectively, identify the articulation points and draw the biconnected components.

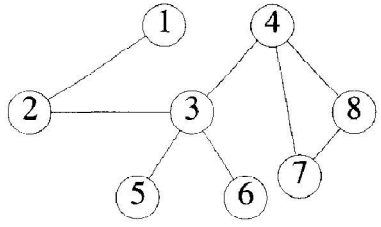

Fig. 2

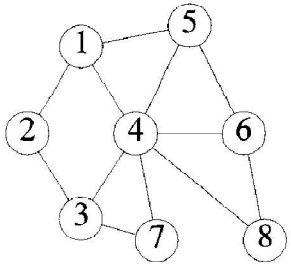

Fig. 3