Roll Number												

Narula Institute of Technology

An Autonomous Institute under MAKAUT

2024

END SEMESTER EXAMINATION - EVEN 2024

CS402 - DESIGN AND ANALYSIS OF ALGORITHMS

TIME ALLOTTED: 3Hours **FULL MARKS: 70**

Instructions to the candidate:

Figures to the right indicate full marks.
Draw neat sketches and diagram wherever is necessary.
Candidates are required to give their answers in their own words as far as practicable

Group A
(Multiple Choice Type Questions)
Answer any ten from the following, choosing the correct alternative of each question: 10×1=10

1.i) Strassen's Matrix Multiplication use _____ Algorithmic paradigm (1) CO2 BL2
a) Divide and conquer
b) Branch and bound
c) Dynamic programming
d) Greedy approach

1.ii) Fractional knapsack problem is solved most efficiently by which of the following algorithm? (1) CO1 BL2
a) Divide and conquer
b) Dynamic programming
c) Greedy algorithm
d) Backtracking

1.iii) Which of the following searching algorithm is fastest? (1) CO1 BL1
a) binary search
b) linear search
c) jump search
d) all are equally fast

1.iv) What is a chromatic number? (1) CO2 BL3
a) The maximum number of colors required for proper edge coloring of graph
b) The maximum number of colors required for proper vertex coloring of graph
c) The minimum number of colors required for proper vertex coloring of graph
d) The minimum number of colors required for proper edge coloring of graph

1.v) Which of the following problems should be solved using dynamic programming? (1) CO3 BL3
a) Mergesort
b) Binary search
c) Longest common subsequence
d) Quicksort

1.vi) What is the running time of the Floyd Warshall Algorithm? a) Big-oh(V) b) Theta(V2) c) Big-Oh(VE) d) Theta(V3)	(1)	CO3	BL5
1.vii) What does Maximum flow problem involve? a) finding a flow between source and sink that is maximum b) finding a flow between source and sink that is minimum c) finding the shortest path between source and sink d) computing a minimum spanning tree	(1)	CO2	BL2
1.viii) Quick sort uses which of the following method to implement sorting? a) partitioning b) selection c) exchanging d) merging	(1)	CO2	BL2
1.ix) Which of the following sorting algorithms has a worst-case time complexity of O(n^2)? a) Merge Sort b) Heap Sort c) Quick Sort d) Bubble Sort	(1)	CO1	BL1
1.x) Which of the following is example of recursion? a) Fibonacci b) Tower of Hanoi c) Factorial d) all of the above	(1)	CO1	BL2
1.xi) The complexity of matrix multiplication algorithm is a) O(n3) b) O(log n) c) O(n4) d) O(n log n)	(1)	CO3	BL3
1.xii) The basic operation of the ___ algorithm is the comparison between the element and the array given. a) Binary search b) Greedy c) Brute Force d) Insertion Sort	(1)	CO1	BL1

Group B
(Short Answer Type Questions)
(Answer any three of the following) 3x5=15

2. Answer the following questions:	(5)		

a) Discuss with example how the asymptotic notation Θ is different from O and Ω.	(3)	CO2	BL2
b) Find the O-notation for the following function: f(n)=10 n^2+7.	(2)	CO3	BL3
3. Consider 5 items along their respective weights and values Items(I)=<I1, I2, I3, I4, I5> Weights(w)=<5, 10, 20, 30, 40> Values(v)= <30, 20, 100, 90, 160> The capacity of the knapsack (W)=60. Use an optimal algorithm to find the maximum profit that can be earned if items are allowed to be taken in fractions.	(5)	CO4	BL4
4. Define P-class, NP-class, NP-hard and NP-complete class and their relation.	(5)	CO2	BL2
5a. What do you mean by approximation algorithm?	(2)	CO5	BL4
5b. Define augmenting path in flow network.	(3)	CO2	BL2
6. Apply master theorem on them. a) $T(n) = 8T\left(\frac{n}{2}\right) + 1000n^2$ b) $T(n) = 2T\left(\frac{n}{2}\right) + 10n$	(5)	CO1	BL6

Group C
(Long Answer Type Questions)
(Answer any three of the following) 3x15=45

7. Answer the following questions:	(15)		
a) Calculate the optimal cost and order of parenthesization to multiply the 4 matrices A, B, C, and D, where the cardinality of all matrices are: A(10X10) B(10X5) C(5X15) D (15X1)	(8)	CO4	BL3
b) Find the optimal solution using 0/1 knapsack problem for knapsack capacity M=30. (w1, w2, w3, w4)=(10, 15, 6, 9) (p1, p2, p3, p4)=(2, 5, 8, 1)	(7)	CO4	BL5

8. Answer the following questions: (15)

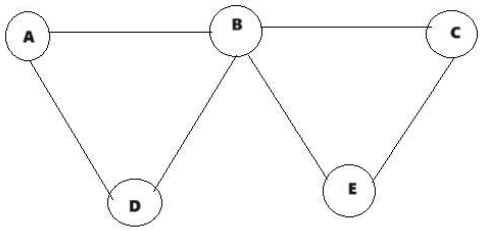
a) Solve **any Two** problems (each question has **equal marks**) : (12) CO4 BL5

i) Use Strassen's algorithm to compute the product of two given square matrices:

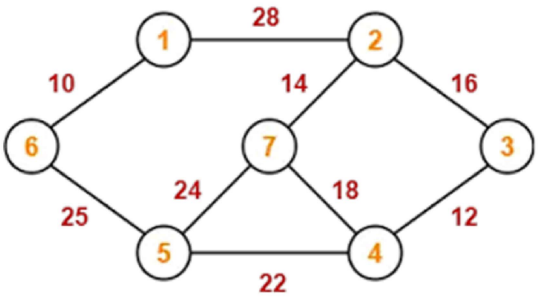
$$\begin{bmatrix}1 & 2\\3 & 4\end{bmatrix} \text{ and } \begin{bmatrix}5 & 6\\7 & 8\end{bmatrix}$$

ii) Calculate an optimal schedule for the job sequencing problem of 7 jobs, where profits = (3, 5, 20, 18, 1, 6, 30) and deadlines = (1, 3, 4, 3, 2, 1, 2).

iii) Determine the chromatic number of the following graph using the backtracking technique.



iv) Determine the MST for the given graph using Prim's algorithm.

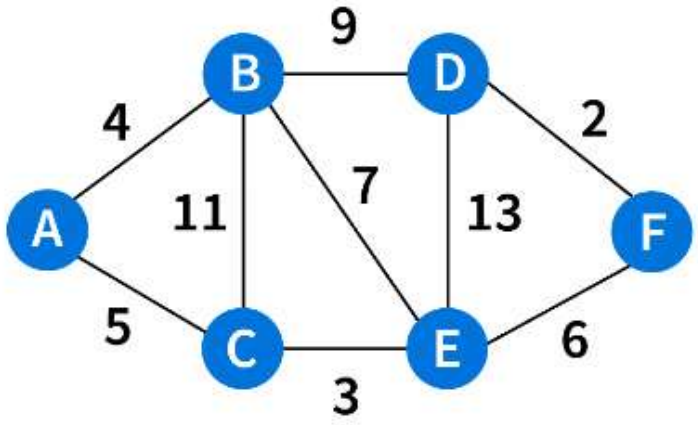


b) Calculate the complexities of the algorithms used to solve the problems. (3) CO5 BL5

9a. Define P class, NP class, Reducibility, NP-complete and NP-hard. (10) CO4 BL2

9b. Explain the relationship among P class, NP class, NP-hard and NP-complete problems. (5) CO4 BL4

10a. (10) CO4 BL4



Apply Dijkstra's algorithm on the above graph.

10b. Show that the worst case complexity of merge sort is O(nlogn). (5) CO2 BL3

11a. Five Jobs with following deadlines and profits. Find out the optimum profit. (5) CO4 BL1

JobID Deadline Profit

a	2	100
b	1	19
c	2	27
d	1	25
e	3	15

11b. Define Spanning Tree and Minimum Spanning Tree with example. (5) CO1 BL1

11c. 10.a) Consider the following example and solve through Dijkstra Algorithm. (5) CO4 BL2