ABC UNIVERSITY OF SCIENCE AND TECHNOLOGY

University Examination Nov-Dec 2023
Fifth Semester of B.Tech. (CE) Examination

DESIGN AND ANALYSIS OF ALGORITHMS [CE355]

Marks: 70 **Duration: 195 mins.**

I

Answer all the questions. Section Duration: 40 mins

1 Given two algorithms, Algorithm X and Algorithm Y, with timecomplexities O(2^n) and O(n!), respectively, which of the followingstatements is true? (1)

1)	Algorithm Y is more efficient than Algorithm X for small input sizes, but Algorithm X becomes more efficient for larger input sizes.		2)	Algorithm X is more efficient than Algorithm Y for all input sizes.		3)	Algorithm Y is more efficient than Algorithm X for all input sizes.		4)	Algorithm X is more efficient than Algorithm Y for small input sizes, but Algorithm Y becomes more efficient for larger input sizes.	

2 Arrange the following functions in ascending order of theirgrowth.
$F1(n)=2^n$, $F2(n)=n^{3/2}$,$F3(n)=n\log_2 n$, $F4(n)=n^{\log_2 n}$ (2)

1)	F3, F2, F1, F4		2)	F2, F3, F1, F4		3)	F2, F3, F4, F1		4)	F3, F2, F4, F1	

3 What is the time complexity of the recursive implementation used tofind the n^{th} Fibonacci term? (1)

1)	Linear		2)	Polynomial		3)	Exponential		4)	None of the above	

4 Consider a minimization problem where finding the optimal solutionis computationally infeasible. Which of the following statementsabout approximation algorithms is true? (1)

1)	Approximation algorithms always guarantee the optimal solution.		2)	Approximation algorithms provide a solution that is arbitrarily close to the optimal solution.		3)	Approximation algorithms trade optimality for efficiency by providing a solution that is guaranteed to be within a certain factor of the optimal solution.		4)	Approximation algorithms are only used for maximization problems.	

5 Which of the following is the correct equation for the matrix chainmultiplication problem where mat[i-1] * mat[i] gives the dimensionof the i^{th} matrix? (1)

1)	dp[i,j] = 1 if i=j dp[i,j] = min{dp[i,k] + dp[k+1,j]}		2)	dp[i,j] = 0 if i=j dp[i,j] = min{dp[i,k] + dp[k+1,j]} + mat[i-1]*mat[k]*mat[j].		3)	dp[i,j] = 0 if i=j dp[i,j] = min{dp[i,k] + dp[k+1,j]}		4)	dp[i,j] = 1 if i=j dp[i,j] = min{dp[i,k] + dp[k+1,j]} + mat[i-1]*mat[k]*mat[j]	

6 Suppose you have candidate set C with coins of differentdenominations and you want to find the change of an amount N. Youhave an infinite supply of each of coins in C. According to greedyalgorithm, which of the following options, with values of C and K,will NOT produce an optimal answer? (1)

1)	C=(1,3,4} and N=6		2)	C=(1,4,9} and N=10		3)	C=(1,3,8} and N=12		4)	C=(1,3,4} and N=100	

7 State true or false: Kruskal's algorithm can work for undirectedgraph only for finding MST. (1)

1)	true		2)	false	

8 State True or false: The Bellman-Ford algorithm indicates whetherthere is a negative-weight cycle that is reachable from the source.If there is such a cycle, the algorithm indicates that no solutionexists. (1)

1)	true		2)	false	

9 Choose the correct option for the following table: (1)

Algorithm	Design approach
A. Huffman coding	i. Dynamic Programming
B.Bellman Ford	ii. Backtracking

Algorithm	Design approach
C.N-Queen	iii. Divide and conquer
D. Strassen's matrix multiplication	iv. Greedy

1)	A-iv, B-i, C-ii, D-iii	2)	A-i, B-iv, C-ii, D-iii	3)	A-iv, B-i, C-iii, D-ii	4)	A-i, B-ii, C-iii, D-iv

10 Assume that the algorithms considered here sort the input sequencesin ascending order. If the input is already in ascending order,which of the following are TRUE? (1)

1)	Quicksort runs in Θ(n^2) time	2)	Bubble sort runs in Θ(n^2) time	3)	Mergesort runs in Θ(n) time	4)	Insertion sort runs in Θ(n) time

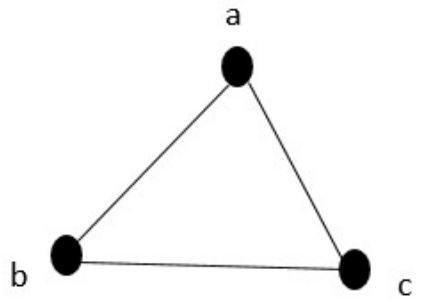
11 Let X be a problem that belongs to the class NP. Then which one ofthe following is TRUE? (1)

1)	There is no polynomial time algorithm for X.	2)	If X can be solved deterministically in polynomial time, then P = NP.	3)	If X is NP-hard, then it is NP-complete.	4)	X may be undecidable.

12 State true or false: In huffman coding, The code length does notdepend on the frequency of occurrence of characters. (1)

1)	true	2)	false

13 How many spanning trees does the given graph have? (2)



1)	1	2)	2	3)	3	4)	4

14 How many comparisons are needed to sort an array of length 5 if astraight selection sort is used and array is already in thedescending order? (1)

1)	4	2)	5	3)	10	4)	20

15 Consider the below table for jobs given with profit and deadline.Find the maximum profit earned. (2)

Job	J1	J2	J3	J4	J5	J6	J7	J8	J9
Profit	15	20	30	18	18	10	23	16	25
Deadline	7	2	5	3	4	5	2	7	3

1)	147	2)	135	3)	150	4)	145

16 What is the basic principle in Rabin Karp algorithm? (1)

1)	Hashing	2)	Sorting	3)	Augmenting	4)	Dynamic Programming

17 What is recurrence and time complexity for worst case of QuickSort? (1)

1)	Recurrence is T(n) = T(n-2) + O(n) and time complexity is O(n^2)	2)	Recurrence is T(n) = T(n-1) + O(n) and time complexity is O(n^2)	3)	Recurrence is T(n) = 2T(n/2) + O(n) and time complexity is O(nLogn)	4)	Recurrence is T(n) = 2T(n/2) +T(1) + O(n) and time complexity is O(n^2)

II

Answer 5 out of 7 questions.

18 State Master Theorem. Solve the following recurrence equationsusing Master Theorem.
a. $T(n) = 3T(n/2) + n^2$
b. $T(n)= \sqrt{2}\, T(n/2) + \log n$ (5)

19 What is the smallest value of n such that an algorithm whoserunning time is $100n^2$ runs faster than an algorithmwhose running time is 2^n on the same machine? Which fromthe below functions take less time to solve any problem? Justifyyour answer:

a. $f(n)=2\, f(n-1) + 1$
b. $f(n)=f(n-1) + n$ (5)

20 What is rate of the growth? What is the significance of it inanalyzing an algorithm? Solve the following recurrence usingrecurrence tree method:
$T(n)=T(n/3) + T(2n/3) + n$ (5)

21 Define: P, NP, NP-complete and NP-hard problem. What is theimportance of approximation algorithms? Give two examples ofapproximation algorithm problems. (5)

22 Suppose that we have 4 tasks(T1,T2,T3,T4) to be performed on 4(A,B,C,D) machines (one task to one machine). Apply the branch andbound method to assign the tasks to the machines at the minimumcost. Following is the table where cost of tasks are mentioned foreach machine.

	T1	T2	T3	T4
A	90	12	50	51
B	70	10	58	80
C	16	85	8	70
D	11	37	80	21

(5)

23 Explain spurious hit in Rabin-Karp string matching algorithm.Working module q=13, How many spurious hits does the Rabin-Karpmatcher encounter in the text T= 2359023141526739921 when lookingfor pattern P = 31415? (5)

24 Derive at least two solutions of 5-queen problem. (5)

III

Answer 5 out of 7 questions.

25 Solve the following 0/1 knapsack problem for optimal solution.There are five items whose weights and values are given infollowing arrays, Weight w[] = { 1,4,5,6,7} and values V[] = {1,6,18,22,28}. Show equation and find out the optimal knapsackitems for weight capacity of 11 units.Assume that each item can beselected only once. (5)

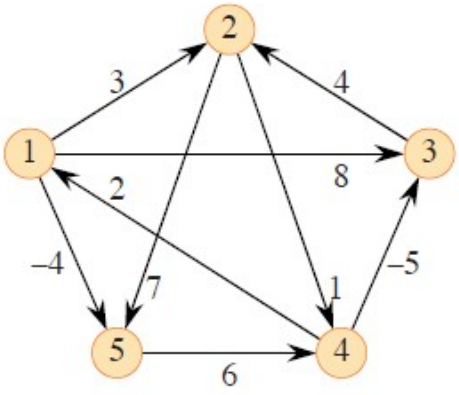
26 Find the complexity of the following code of finding the power ofany number,where n is the exponent.

```
for(int i=1; i< =n; i++)
{
power = power * base;
}
```

Apply the appropriate method to find 2^{16} with complexityO(logn). (5)

27 Show that recursive solution of finding longest common subsequence(LCS) has overlapping subproblems for the following givenstrings.Also apply dynamic programming solution for findingLCS.
S1: PQRPPR
S2: QPRP (5)

28 Write the equation for the Floyd-warshall algorithm.Show the matrixD(k) that results for each iteration on the given weighted,directed graph. (5)

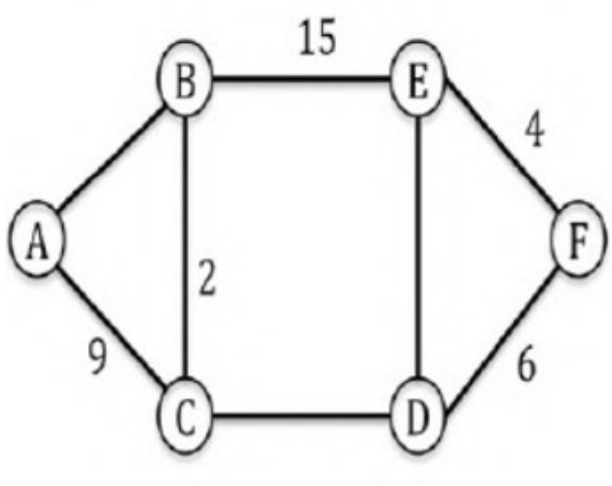


29 Consider that ABC academy is offering eight courses during itssummer session. The table shows with an X which pairs of courseshave one or more common students. Find the minimum number of timeslots required to schedule the lectures of all courses in oneday. (5)

	Big data	IoT	Blockchain	AI	Image processing	Machine Learning	Virtual reality	Cyber security
Big data		×		×	×	×		×
IoT	×				×	×		
Blockchain						×	×	×
AI	×							×
Image processing	×	×				×		
Machine Learning	×	×	×		×		×	
Virtual reality			×			×		
Cyber security	×		×	×				

30		

Define Minimum Spanning Tree(MST). Given graph has eight edges withunique integer edge weights. The MST of given graph consists ofedges {(A,C), (B,C),(B,E),(E,F),(D,F)} and has weight 36. Edgeweights are given in the graph of only those edges which are inMST. Find the minimum possible sum of weights of all eight edges ofgiven graph. Mention the algorithm or method you can use to findthe solution.



(5)

31		

Differentiate Dynamic programming, greedy approach and divide andconquer with suitable examples. (5)

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