

KATHMANDU UNIVERSITY  
End Semester Examination [C]  
December, 2024

Marks Scored:

Level : B.Tech.

Course : AICS 202

Year : II

Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 11 Dec.

SECTION "A"

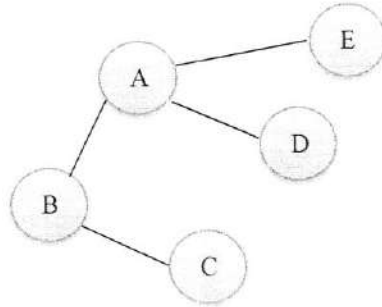
[20Q.  $\times$  0.5 = 10 marks]

**Choose and encircle in the most appropriate option from each set of choices.**

- What is the purpose of asymptotic notation in algorithm analysis?
  - To precisely measure the exact number of operations in an algorithm
  - To provide a rough estimate of algorithmic performance
  - To compare algorithms based on their exact execution times
  - To simplify the comparison of algorithms based on their growth rates
- What is the solution to the recurrence relation  $T(n) = 2T(n/2) + n$ ?
  - $O(2^n)$
  - $O(n^2)$
  - $O(n \log n)$
  - $O(n)$
- What is the disadvantage of using Splay trees?
  - Height of a splay tree can be linear when accessing elements in non-decreasing order.
  - Splay operations are difficult.
  - No significant disadvantage.
  - Splay tree performs unnecessary splay when a node is only being read.
- Time taken in decreasing the node value in a binomial heap is \_\_\_\_\_
  - $O(n^2)$
  - $O(\log n)$
  - $O(n \log n)$
  - $O(n^2 \log n)$
- Given an array  $arr = \{12, 13, 35, 78, 56\}$  and  $key = 78$ . How many iterations are done until the element is found using Binary search?
  - 1
  - 2
  - 3
  - 4
- If one uses straight two-way merge sort algorithm to sort the following elements in ascending order then the order of the array elements 20, 47, 15, 8, 9, 4, 40, 30, 12, 17 after second pass will be:
  - 4, 8, 9, 15, 20, 47, 12, 17, 30, 40
  - 8, 9, 15, 20, 47, 4, 12, 17, 30, 40
  - 15, 20, 47, 4, 8, 9, 12, 30, 40, 17
  - 8, 15, 20, 47, 4, 9, 30, 40, 12, 17
- What does Maximum flow problem involve?
  - finding a flow between source and sink that is maximum
  - finding a flow between source and sink that is minimum
  - finding the shortest path between source and sink
  - computing a minimum spanning tree
- Which among the following represents best-case time complexity for activity selection problem?
  - $O(1)$
  - $O(n)$
  - $O(n \log n)$
  - $O(n^2 \log n)$

9. Which of the following is a property of a dynamic programming problem?
- Require More Time
  - Greedy Approach
  - Optimal Substructure and Overlapping Sub problems
  - Evolutionary Approach
10. Consider the two matrices P and Q which are of order  $10 \times 20$  and  $20 \times 30$  respectively. What is the number of multiplications required to multiply these matrices?
- $10 \times 20$
  - $20 \times 30$
  - $10 \times 30$
  - $10 \times 20 \times 30$
11. Of the following given options, which one of the following is a correct option that provides an optimal solution for 4-queens problem?
- (4,3,2,1)
  - (4,2,3,1)
  - (3,1,4,2)
  - (2,3,1,4)
12. Which of the following is not true about subset sum problem?
- the recursive solution has a time complexity of  $O(2^n)$
  - there is no known solution that takes polynomial time
  - the recursive solution is slower than dynamic programming solution
  - the dynamic programming solution has a time complexity of  $O(n \log n)$
13. If GCD of two numbers is 1, then the two numbers are said to be \_\_\_\_\_
- prime number
  - co-prime number
  - composite number
  - rational number
14. What is the pre-processing time of Rabin and Karp Algorithm?
- $O(m)$
  - $O(m^n)$
  - $O(m+n)$
  - $O(m \log n)$
15. What is the main characteristics of a Monte Carlo algorithm?
- It produces correct result with high probability but not always.
  - It always produces a correct result in a fixed time.
  - It solves problems without randomness.
  - It solves problems using recursion.
16. Parallel algorithms are designed to \_\_\_\_\_
- minimize memory usage
  - solve problems sequentially
  - perform random tasks
  - divide tasks among processors to reduce computation time
17. In an approximation algorithms, the performance ratio is defined as:
- the ratio of the approximate solution to the optimal solution
  - the number of the iteration required
  - the time complexity of the algorithm
  - the size of the inputs

18. What is the minimum vertex cover for the following graph given below?



- a. {B, C}                      b. {D, B}                      c. {A, B}                      d. {A, E}
19. Which of the following is correct for the given phrase?  
Phrase: - "*Solvable by non-deterministic algorithms in polynomial time*"
- a. NP Hard Problems  
b. NP- Complete Problems  
c. During control flow, non-deterministic algorithm may have only one choice  
d. If the choices that non deterministic algorithm makes are correct, the amount of time it takes is unbounded by polynomial time.
20. Non-deterministic algorithms differs from deterministic algorithm in that they \_\_\_\_\_
- a. use a divide and conquer approach  
b. always produce optimal solution  
c. runs faster than deterministic algorithm  
d. guess solution and verify correctness



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SECTION "B"  
[6 Q. × 4 = 24 marks]

Attempt *ANY SIX* questions.

1. Explain the best case, average case and worst case of an algorithm analysis with suitable example.
2. What is a Red-Black Tree? Illustrate the concept of inserting a new node in a Red-Black tree with suitable example.
3. Why Huffman coding is used? A file contains the following characters with the frequencies as shown.

<b>Characters</b>	a	e	i	o	u	s	t
<b>Frequencies</b>	10	15	12	3	4	13	1

- If Huffman Coding is used for data compression, determine-
- a. Huffman Code for each character
  - b. Average code length
  - c. Length of Huffman encoded message (in bits)
4. Illustrate the solution to 4-queen problem using backtracking approach.
  5. Discuss Extended Euclidean Algorithm for solving modular linear equations. Use the algorithm to find the value of  $s$  and  $t$  in the equation  $GCD(35,27)=35s+27t$
  6. Explain Miller-Rabin Algorithm of Primality testing. Test whether 561 is prime or not using Miller-Rabin method.
  7. Explain the classes of NP hard and NP Complete problems.

SECTION "C"  
[2Q. × 8 = 16 marks]

Attempt *ANY TWO* questions.

8. Discuss Quick Sort algorithm with suitable example and analyze the performance of quick sort algorithm. [3+3+2]
9. Write an algorithm to compute the LCS of given two sequences. Trace the running of the algorithm to find the LCS of the sequences "XMJYAUZ" and "MZJAWXU". [4+4]
10. What is a Subset Sum Problem? Discuss the approximation algorithm for solving the Subset Sum Problem with suitable example. [1+4+3]

