Panchkhel

KATHMANDU UNIVERSITY
End Semester Examination
March/April, 2025

Marks Scored:

Level : B.Tech.
Year : II
Course : AICS 202
Semester : I

Exam Roll No. :
Time: 30 mins.
F. M. : 10

Registration No.:
Date : 8 April 2025

SECTION "A"
[20Q. × 0.5 = 10 marks]

Select and mark [X] in the most appropriate answers.

1. If an algorithm has a recurrence relation $T(n) = 2T(n/2) + n^2$, what is its time complexity?
[ ] O(n log n) [ ] $O(n^2)$ [ ] $O(n^3)$ [ ] O(log n)

2. The amortized time complexity of the Extract-Min operation in a Fibonacci heap is:
[ ] O(log n) [ ] O(1) [ ] O(n) [ ] O(n log n)

3. The Master Theorem cannot be applied when:
[ ] The recurrence is of the form $T(n) = aT(n/b) + f(n)$
[ ] f(n) is asymptotically smaller than T(n/b)
[ ] f(n) is polynomially larger than T(n/b)
[ ] f(n) is an exponential function

4. The time complexity of the Longest Common Subsequence (LCS) problem using Dynamic Programming is:
[ ] O(m+n) [ ] O(mn) [ ] O(log m + log n) [ ] O(n log n)

5. The time complexity of solving the N-Queen problem using the backtracking approach is:
[ ] O(n) [ ] $O(n^2)$ [ ] O(n!) [ ] O(log n)

6. Which algorithm is used to construct an optimal prefix-free binary code?
[ ] Dijkstra's Algorithm [ ] Divide and Conquer
[ ] Huffman Coding [ ] Backtracking

7. Which one of the following is NOT a Number Theoretic Algorithm?
[ ] RSA Algorithm [ ] Bloom Filter
[ ] Modular Exponentiation [ ] Solving Modular Linear Equations

8. Which of the following operations **does not** require rotation in a Red-Black Tree?
[ ] Insertion [ ] Deletion [ ] Search [ ] Balancing

9. Which of the following is true about the Knuth-Morris-Pratt algorithm?
[ ] It has a worst-case time complexity of O(nm)
[ ] It preprocesses the pattern before searching
[ ] It is based on a hashing technique
[ ] It is used for cryptography

10. The worst-case time complexity of Rabin-Karp algorithm in string matching is:
[ ] O(m+n) [ ] O(m log n) [ ] $O(n^2)$ [ ] O(nm)

11. A Binomial Heap consists of:
[ ] A collection of binary heaps
[ ] A collection of AVL trees
[ ] A collection of binomial trees
[ ] A single balanced tree

12. The In Monte Carlo algorithms, the output is:
[ ] Always correct
[ ] Sometimes incorrect but runs in polynomial time
[ ] Deterministic and optimal
[ ] Based on exhaustive search

13. The polynomial-time reducibility property states that:
[ ] Every NP-complete problem can be reduced to every other NP-complete problem
[ ] An NP problem is solvable in polynomial time
[ ] A problem can only be classified as NP if it has a polynomial-time solution
[ ] Only deterministic problems can be reduced

14. In the context of RSA encryption, which mathematical operation is crucial?
[ ] Matrix multiplication
[ ] Modular exponentiation
[ ] Sorting
[ ] Finding shortest paths

15. Which of the following is used to check polynomial-time verification of an NP problem?
[ ] Reduction Method
[ ] Complexity Classes
[ ] P vs NP problem
[ ] Cook's Theorem

16. A problem is said to be NP-complete if:
[ ] It is in NP and is at least as hard as any problem in NP
[ ] It can be solved in polynomial time
[ ] It is undecidable
[ ] It cannot be solved at all

17. The purpose of an Approximation Algorithm is to:
[ ] Find the exact solution
[ ] Provide an optimal solution always
[ ] Find a near-optimal solution in polynomial time
[ ] Reduce problem complexity to O(1)

18. The Primality Testing Algorithm in Monte Carlo methods is used to:
[ ] Determine if a number is prime with certainty
[ ] Approximate prime numbers with high probability
[ ] Factorize a number efficiently
[ ] Solve NP-complete problems

19. The number of binomial trees in a binomial heap with 29 elements is:
[ ] 5 [ ] 3 [ ] 4 [ ] 6

20. If P = NP, what would be the consequence?
[ ] All problems in NP can be solved in polynomial time
[ ] No NP-complete problem would exist
[ ] Every problem would be undecidable
[ ] Cryptography would remain secure

KATHMANDU UNIVERSITY
End Semester Examination
March/April, 2025

Level : B.Tech.
Year : II
Time : 2 hrs. 30 mins.

8 April 2025

Course : AICS 202
Semester : I
F. M. : 40

SECTION "B"
[6Q. × 4 = 24 marks]

Attempt *ANY SIX* questions.

1. Write an algorithm for insertion sort and analyze its time complexity.

2. Given the insertion sequence {10,20,30,40,50}in an initially empty splay tree, explain the insertion process and analyze its amortized time complexity.

3. Trace the backtracking steps for solving sum of subsets for the set {3,5,6,7,2,1}and target sum=8.

4. Construct the Huffman Encoding Tree for the string "MISSISSIPPI" and derive its encoding.

5. Explain the approximation for solving vertex cover with a suitable example.

6. Perform RSA encryption and decryption on the plaintext message "HELLO". Use the following parameters: p=11, q=17 and e=7.

7. Compare KMP Algorithm and Rabin-Karp Algorithm for string matching.

SECTION "C"
[2Q. × 8 = 16 marks]

Attempt *ANY TWO* questions.

8. Explain the difference between Big-O, Theta (Θ), and Omega (Ω) notations with examples. Solve the recurrence relation $T(n) = 2T(n/2) + n \log n$ using the Master Theorem.

9. Write short notes on ***ANY TWO***:
   a. NP Hard Problems and NP Completeness
   b. Ford-Fulkerson Algorithm
   c. LogLog algorithm
   d. Bloom Filters

10. Write the dynamic programming algorithm for matrix chain multiplication. Find the optimal parenthesization for the matrix chain product ABCD with size of each is given as $A_{5\times10}$, $B_{10\times15}$, $C_{15\times20}$, $D_{20\times30}$