KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2023

Marks Scored:

Level : B.Tech.
Year : II

Course : AICS 202
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : July-13

SECTION "A"
[20Q. × 0.5 = 10 marks]

Encircle the most appropriate option from each set of choices.

1. Let f(n) = n and g(n) = $n^{(1+\sin n)}$ where n is a positive integer. Which of the following statement(s) is/are true?
   I. f(n) = O(g(n))
   II. f(n) = Ω(g(n))

   a. Only I
   b. Only II
   c. Both I and II
   d. Neither I nor II

2. The running time for the following "for" loops is_____.

```
Sum = 0;
for (i = 0; i<n; i++)
      for (j = 0;  j<n*n; j++)
          sum ++;
```

   a. $O(n^3)$ b. $O(n^2)$ c. O(n) d. O(1)

3. Why Red-Black trees are preferred over hash tables through hash tables have constant time complexity?
   a. No they are not preferred.
   b. Because they are balanced.
   c. Because they can be implemented using trees.
   d. Because of resizing issues of hash table and better ordering in red-black trees.

4. The number of trees in a binomial heap with *n* nodes is _____.
   a. n b. nlogn c. logn d. n/2

5. Let T (n) be the function defined by
   T (1) = 1
   T (n) = 2T (n/2) + $\sqrt{n}$ for n ≥ 2
   Which of the following statements is true?

   a. T(n) = O(n)
   b. (n) = O($\sqrt{n}$)
   c. T(n) = O(nlog n)
   d. T(n) = O(logn)

6. The average successful search time taken by Binary Search on a sorted array of 10 items is_____.
   a. 2.6 b. 2.7 c. 2.8 d. 2.9

7. In activity selection problem, each activity ***i*** has a start time s_i and a finish time f_i, where $s_i \leq f_i$. Activities ***i*** and ***j*** are compatible if _____.
   a. $s_i \geq f_j$
   b. $s_j \geq f_i$
   c. $s_i \geq f_j$ or $s_j \geq f_i$
   d. None

8. The Huffman coding algorithm constructs an optimal prefix code for a string of length n with d distinct character in _____ time.
   a. O(n + d)
   b. O(log n + d)
   c. O(n + logd)
   d. O(n + dlogd)

9. Let A1, A2, A3 and A4 be four matrices of dimensions 10×5, 5×20, 20×10 and 10×5 respectively. Then the minimum number of scalar multiplication required to find the product A1.A2.A3.A4 using basic matrix multiplication method is_____.
   a. 500 b. 1000 c. 1500 d. 2000

10. How many possible solutions exist for an 8-Queens problem?
   a. 88 b. 92 c. 98 d. 100

11. Let a and b be two positive integers then for any integer r, GCD(a, b) will be_____.
   a. GCD(a, b) = GCD(b, a – rb)
   b. GCD(a, b) = GCD(r, b – ra)
   c. GCD(a, b) = GCD(a, b – ra)
   d. GCD(a, b) = GCD(0, r – ab)

12. If p = 17 and q = 7, with e = 11 the message m = 21 is encrypted as_____.
   a. 98 b. 89 c. 35 d. 53

13. The worst-case running time of the KMP algorithm is _____.
   a. O(n) b. O(2n) c. $O(n^2)$ d. $O(n^3)$

14. What is the basic principle in Rabin Karp algorithm?
   a. Sorting
   b. Augmenting
   c. Dynamic Programming
   d. Hashing

15. If x, n are positive integers such that $x^2 = 1 \pmod n$ but $x \neq \pm 1 \pmod n$, then n is _____.
   a. Prime
   b. Composite

16. Sorting takes O (n log n) in the serial case. If we have p processors, then reasonable algorithms should take _____ time.
   a. O(n - p log n) b. O(n + p log n) c. O(n * p log n) d. O(n / p log n)

17. An approximation algorithm guarantees to run in _____ time though it does not guarantee the most _____ solution.
   a. polynomial, effective
   b. polynomial, abortive
   c. non-polynomial, effective
   d. non-polynomial inefficient

18. What is a subset sum problem?
   a. finding a subset of a set that has sum of elements equal to a given number
   b. checking for the presence of a subset that has sum of elements equal to a given number and printing true or false based on the result
   c. finding the sum of elements present in a set
   d. finding the sum of all the subsets of a set

19. The relationship between ***P*** and ***NP*** algorithms is _____.
   a. P = NP b. $NP \subseteq P$ c. $P \subseteq NP$ d. $P \leq NP$

20. Let ***S*** be a ***NP-Complete*** problem, ***Q*** and ***R*** be two other problems not known to be in ***NP***. ***Q*** is polynomial-time reducible to ***S*** and ***S*** is polynomial-time reduction to ***R***. Which one of the following statement is true?
   a. R is NP-Complete
   b. R is NP-hard
   c. Q is NP-Complete
   d. Q is NP-hard

KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2023

julep-13

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

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

SECTION "B"
[6Q. × 4 = 24 marks]

Attempt *ANY SIX* questions.

1. What do you mean by analysis of algorithm? Write an algorithm for Binary Search and analyze it.

2. Find the optimal solution to the Knapsack instance n = 5, W = [20, 30, 40, 10, 7], P = [7, 8, 9, 1, 6] and C = 80 using greedy method.

3. Discuss the dynamic programming solution to longest common subsequence (LCS) problem.

4. Show that the element $x > 0$ of Z_n has a multiplicative inverse in Z_n if and only if $gcd(x,n) = 1$.
(Note: Z_n *is the set of non-negative integers less than* n)

5. Using Rabin Karp string matching algorithm match the given pattern P with the given string S.
P = 745
S = 745727457

6. Discuss Miller-Rabin Algorithm Primality testing with suitable example.

7. Write short notes on:
a. Approximation algorithms
b. NP Completeness

SECTION "C"
[2Q. × 8 = 16 marks]

Attempt *ANY TWO* questions.

8. Let $T(n) = a\,T(n/b) + n^c$, then show that $T(n) = \theta(n^{\log_b a})$, if $a > b^c$, otherwise $T(n) = \theta(n^c)$. [4+4]

9. Explain Binomial Heap and Binomial Tree Properties. Illustrate the concept of extracting minimum key in a binomial heap with suitable example. [2+2+2+2]

10. Write a recursive backtracking algorithm for sum of subsets problem. Use the algorithm for finding subset of elements S in the gives set X = {5, 10, 12, 13, 15, 18} such that their sum M is 30. [4+4]