AUTUMN MAKEUP MID SEMESTER EXAMINATION-2022

School of Computer Engineering
Kalinga Institute of Industrial Technology, Deemed to be University
Design & Analysis of Algorithms
[CS 2012]

Time: 1 1/2 Hours **Full Mark: 20**

Answer any four Questions including Q.No.1 which is Compulsory.
The figures in the margin indicate full marks. Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

1. Answer all the questions. [1 x 5]

a) In the following C function, let $n \geq m$.

```
int gcd (n, m) {
 if (n%m == 0)
      return m;
   n = n%m;
      return gcd (m, n);
}
```

Which of the following is correct regarding the number of recursive calls made by the above function? Justify your answer.

a) $\Theta(\log n)$ b)$\Omega(n)$ c)$\Theta(\log \log n)$ d)$\Theta(\sqrt{n})$

b) Consider the array A={40,90,10,20,60,80,50} Quick sort is run on the array A and assume that the algorithm picks last element as pivot. In how many ways can the element present in the array be arranged so that the effect of first pass of quick sort algorithm is preserved?

c) A text is made up of the characters a, b, c, d, e each occurring with the probability 0.11, 0.40, 0.16, 0.09 and 0.24 respectively. The optimal Huffman coding technique will have an average length of

a) 2.40 b) 2.16 c) 2.26 d) 2.15

d) Let the height of a heap be 'h', what is the maximum possible number of nodes present in the heap?

a) 2^(h+1) b) 2^(h+1)-1 c) 2^h + 2 d) 2^(h+1) +1

e) Consider X = 1001110101001 and Y = 111001110011. Let Z = z1 z2 z3… zk be the LCS of X and Y. What will be the value of zk. Justify your answer.

2. a) Consider the following recurrence relation: [3 Marks]

$$T(n) = \begin{cases} 1, & \text{if } n = 1 \\ 2T(n-1) + 2^n, & \text{otherwise} \end{cases}$$

Solve the above recurrence relation and derive the asymptotic expression for $T(n)$.

b) Arrange the following functions in Ascending order [2 Marks]

F1=log(n!), F2=4n, F3=2logn, F4=n!

3. Given an array of elements {5, 3, 1, 6, 8, 7, 9, 4}. Sort the given array in descending order using heap sort. Show the steps and intermediate contents of the array during the sorting process. Write an algorithm for the same. [5 Marks]

4. Write an algorithm for knapsack problem using greedy method. Suppose we have a knapsack that can hold at most **7 pounds**. The table below lists the weight and value of four items. Assume we can pack fractions of the items. Use a greedy algorithm to solve this fractional knapsack problem (i.e.,maximizing the total value of packed items). Show your work. [5 Marks]

Item	Weight	Value
1	2 pounds	$3.00
2	3 pounds	$2.00
3	4 pounds	$4.00
4	5 pounds	$1.00

5. Write an algorithm for matrix chain multiplication to find minimum number of scalar multiplications using bottom up approach in dynamic programming. Also find the minimum number of scalar multiplication for the following given arrays.

A1(5x4) A2(4x6) A3(6x2) A4(2x7) [5 Marks]

*** Best of Luck ***