Course Code: CIT 310
Course Title: Algorithms and Complexity Analysis
Credit: 3 Units
Time allowed: 2½ Hours
Instruction: Answer Questions **ONE (1)** and any other **THREE (3)**
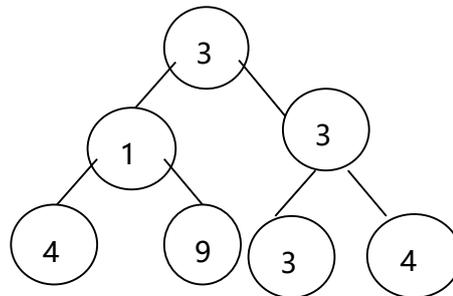
Question One
a. Devise an algorithm to calculate the sum of *N* integers **(5Marks)**
b. Write a simple algorithm to calculate the number of absentees in a class of 45 students. **(6Marks)**
c. Explain the steps to search for 56 using Linear Search from the array of number 23, 34, 56, 67, 84 **(5Marks)**
d. With the help of a flow chart, describe the evaluation of 5 factorial (5!) **(6Marks)**
e. Enumerate the three (3) laws of recursion **(3Marks)**

Questions Two
a. State three (3) disadvantages of insertion sort algorithm **(3Marks)**

b. Generate a relation formula for total time taken to move *n* disks from peg A to peg C in the Tower of Hanoi Algorithm **(5Marks)**
c. Write an algorithm to implement bubble sort **(7Marks)**

Questions Three
a. List three (3) applications of Tower of Hanoi **(3Marks)**
b. Given the Binary Search Tree below with key [x] = 37. State the value of key[y] **(4Marks)**:
   (i)   If y is a node in the left subtree of x
   (ii)   If y is a node in the right subtree of x

c. Sort this array of numbers 12 45 23 48 10 in ascending order, using the bubble sort algorithm **(8Marks)**

Question Four
a. Write an Algorithm to implement Selection Sort **(4Marks)**
b. Given three pegs A, B, C, show with illustrative diagrams the 7 steps for transferring all the disks from peg A to peg C in the Tower of Hanoi algorithmic problem **(7Marks)**
c. Briefly explain any three disadvantages of a pseudocode. **(3Marks)**

Question Five
a. Enumerate four (4) characteristics of Algorithm **(4Marks)**
b. Write short notes on recurrence relation **(6Marks)**
c. Using substitution method, show that $T(n) = T\left(\frac{n}{2}\right) + n$ is asymptotically bounded by O(logn) **(5Marks)**

Question Six
a. Devise an algorithm to implement quick sort **(6Marks)**
b. Distinguish between Binary Search Tree and Red-Black Tree **(6Marks)**
c. Explain the two (2) properties of a Binary Search Tree **(3Marks)**