Q1. Answer the questions given in the comments of the following code. If you think, there is an error in the code, mention and correct the error and answer the questions accordingly. No code is required for this question:

[CLO 1] [2+2+2+3+3=10]

```
std::stack<char> STK;
std::queue<char> QUE;
std::list<char> LST;
std::priority_queue<char> PQ;
std::set<char> SET;
std::map<char, char> MAP;

int i=1;
for (char c = 'a'; c <= 'o'; c++) {
    if (i % 2 == 0) {
        STK.push(c);
    }
    if (i % 3 == 0) {
        QUE.push(c);
    }
    ++i;
}
//(a) what values STK and QUE would contain at this point?

while (!QUE.empty()) {
    PQ.push(STK.top());
    PQ.push(QUE.front());
    STK.pop();
    QUE.pop();
}
//(b) what values PQ would contain at this point?

while (!PQ.empty()) {
    LST.push_back(PQ.top());
    PQ.pop();
    if (!STK.empty()) {
        LST.push_front(STK.top());
        STK.pop();
    }
}
//(c) what values LST would contain at this point?

for (auto it = LST.rbegin(); it != LST.rend(); ++it) {
    SET.insert(*it);
    auto it2 = it;
    ++it2;
    if (it2 != LST.rend()) {
        MAP.insert({*it, *it2});
    }
}
//(d) what values SET and MAP would contain at this point?


for (auto it3 = MAP.begin(); it3 != MAP.end(); ++it3) {
    std::cout << it3->first << ": " << it3->second << std::endl;
}
//(e) what will be the output of the loop above this comment?
```

DSA FORMULA SHEET

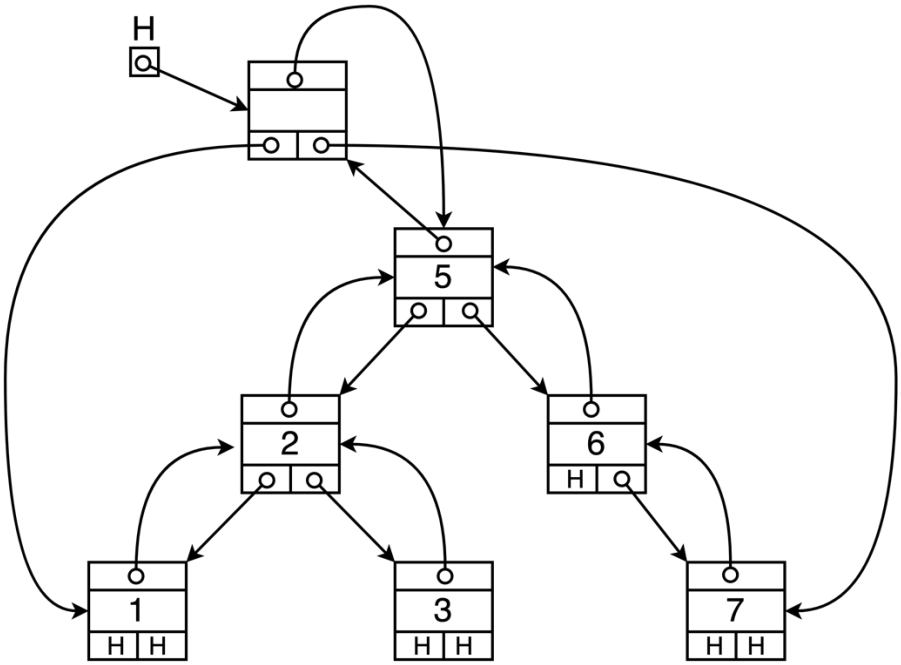
1. Total Nodes in full map/tree: $n=2^h-1$
2. Height of full map/tree: $h=\log_2(n+1)$
3. Left child: $i*2+1$
4. Right child: $i*2+2$
5. Parent: $(i-1)/2$
6. First leaf: $(n/2)$
7. Range of chaining: $[n/10,n/5]$
8. Range of open addressing: $[n*1.3,n*1.7]$
9. Linear Hashing: $(h + i)\%size$
10. Quadratic Hashing: $(h + i*i)\%size$
11. Double Hashing: $(h1 + i*(h2+1))\%size$

Q2. What will be the output of the following code when the code `f(5)` is executed? Also draw the recursion tree. No code is required for this question:

[CLO 1] [6]

```
int f(int n) {
    if (n > 50)
      return n;
    else if (n > 25)
      return f(n+10);
    else
      return 2*n + f(n+10) + f(n+20);
}
```

Q3. Assume that a binary search tree is represented using following linked structures. The nodes have four parts: a value part and pointers to the left child, right child, and parent nodes. Answer this question based on the linked structures given below: [CLO 1] [1+2+3+3+5=14]



a) Write a single line of code to display the value 3.

b) Write a single line of code to check whether the value in the left child of dummy head is less than the value in the right child of the dummy head. The address of dummy head (H) is stored in the pointer H.

c) Write code to insert a new value 4 in the BST. The properties of the BST should remain intact. Do not use a loop.

d) Write code to delete the node with value 6. The properties of the BST should remain intact. Do not use a loop.

e) Write code to display the values in the list in reverse order using a loop and without using an iterator.

Q4. How an empty AVL tree look like after inserting the following values in the given order? Show all the intermediate steps. No code is required for this question: 1, 6, 3, 7, 4, 5, 2 [CLO 1] [6]

Q5. How would an empty max-heap structure look like after inserting the following values in the given order? Show all the intermediate steps. No code is required for this question: 2, 4, 8, 7, 6, 5, 1, 10, 3, 9, 11. [CLO 1] [6]

Q6. Give brief solutions for the following problems. Justify your answer based on time complexity of the solution and the appropriateness of the data structure(s) you choose. No code is required for this question. [CLO 2] [2x4=8]

a) Find the frequencies of words in a text document (how many times a word appears in the document).

b) Implementing the undo functionality in a software.

c) Implementing a queue of patients in a way that elder patients are treated first before the younger ones, irrespective of their arrival time in the hospital.

d) Searching student records based on their registration numbers.