**Proposed solution for Task 1**

**Name – Amir Khan**

**Code File Name – solution1.ipynb**

1.

[1,5,7,10]

0001

0101

0111

1010

Creating Oracle

No of stated for each 4 bits number –

0 – 15

|0000>, |0001>,………|1111>

Suppose w = 0101, 1010 <--- target

Grover’s algorithm solves oracles that add a negative phase to the solution states.

For any state |x>

In the computational basis;

-|x if x = w

|x if x not equal w

The oracle will be a diagonal matrix, where the entry that corresponds to the w will have a negative phase

If we have 4 qubits and w = 0101 and 1010

Our oracle matrix will have the matrix:

1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 -1 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 -1 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1

create a function f that takes a proposed solution x, and returns f(x)=0,

if x is not a solution (x≠ω) and f(x)=1

for a valid solution (x=ω).

For 4 qubits

Amplitude 5 and 10 grows linearly with numbers 0……5…..10…..15

N = 16

Theta = arcsin(1/4)

No of rotations, R = sqrt(N/2) == 3 approx

2.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

We create a truth table

So our target is 5 and 10 then

Index of every number will be 0 except target one

0000010000100000

Then we create truth table oracle

Using TruthTableOracle

After that apply Grover on our Oracle

And run on simuator