LAB 8

OBJECTIVE

To find gcd of two numbers using the Euclidean algorithm and find the Totient function

THEORY

In mathematics, the Euclidean algorithm, or Euclid's algorithm, is an efficient method for computing the greatest common divisor (GCD) of two numbers, the largest number that divides both of them without leaving a remainder. This method is very handy when the numbers are very big.

The Euclidean Algorithm for finding GCD(A,B) is as follows:

- If A = 0 then GCD(A,B)=B, since the GCD(0,B)=B, and we can stop.
- If B = 0 then GCD(A,B)=A, since the GCD(A,0)=A, and we can stop.
- Write A in quotient remainder form ($A = B \cdot Q + R$)
- Find GCD(B,R) using the Euclidean Algorithm since GCD(A,B) = GCD(B,R)

Euler's totient function counts the positive integers up to a given integer n that are relatively prime to n. It is written using the Greek letter phi as $\varphi(n)$ or $\phi(n)$, and may also be called Euler's phi function. In other words, it is the number of integers k in the range $1 \le k \le n$ for which the greatest common divisor gcd(n, k) is equal to 1. The integers k of this form are sometimes referred to as totatives of n.

CODE

```
# Python program to calculate GCD using Euclidean algorithm and
calculate the totient function

a = int(input("Enter first number : "))
b = int(input("Enter second number : "))

def gcd(a, b):
    if a < b:
        return gcd(b, a)
    if b != 0:
        return gcd(b, a % b)
    else:
        return a

print(f"GCD of {a} and {b} : {gcd(a,b)}")

def Φ(n):
    count = 0
    print(f"The numbers smaller than {n} and relatively prime to {n}
are : ")
    for i in range(1, n):
        if gcd(i, n) == 1:
            count = count + 1
            print(i)
    print(f"∴ Φ({n}) = {count}")

Φ(21)
```

OUTPUT

```
Enter first number : 294
Enter second number : 105
GCD of 294 and 105 : 21
The numbers smaller than 21 and relatively prime to 21 are :
1
2
4
5
8
10
11
13
16
17
19
20
∴ Φ(21) = 12
```

CONCLUSION

In this lab, we got familiar with the Euclidean algorithm, implemented it to get the gcd of two numbers and found the Totient function of that number.