EXP NO: 2a
DATE:

RSA ALGORITHM

AIM:

To write a python program to implement RSA Algorithm.

ALGORITHM:

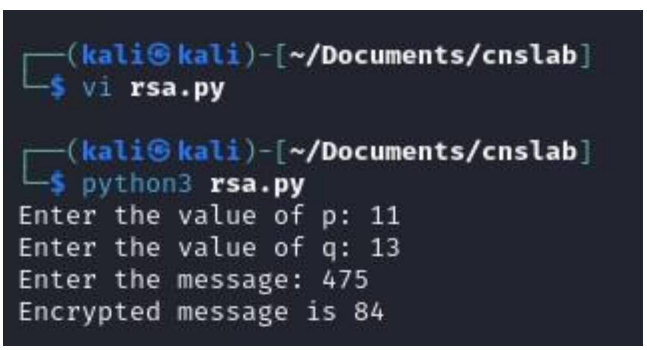
1. Select two large prime numbers, p and q.
2. Multiply these numbers to find n = p x q, where n is called the modulus for encryption and decryption.
3. Choose a number e less than n, such that n is relatively prime to (p - 1) x (q -1). It means that e and (p - 1) x (q - 1) have no common factor except 1. Choose "e" such that 1<e < φ (n), e is prime to φ (n), gcd (e,d(n)) =1
4. If n = p x q, then the public key is <e, n>. A plaintext message m is encrypted using public key <e, n>. To find ciphertext from the plain text following formula is used to get ciphertext C.
   C = me mod n
5. Here, m must be less than n. A larger message (>n) is treated as a concatenation of messages, each of which is encrypted separately.
6. To determine the private key, we use the following formula to calculate the d such that:
   De mod {(p - 1) x (q - 1)} = 1
   Or
   De mod φ (n) = 1
7. The private key is <d, n>. A ciphertext message c is decrypted using private key <d, n>. To calculate plain text m from the ciphertext c following formula is used to get plain text m.

PROGRAM:

```
from math import gcd

# defining a function to perform RSA approch
def RSA(p: int, q: int, message: int):
    # calculating n
    n = p * q

    # calculating totient, t
    t = (p - 1) * (q - 1)

    # selecting public key, e
    for i in range(2, t):
        if gcd(i, t) == 1:
            e = i
            break

    # selecting private key, d
    j = 0
    while True:
        if (j * e) % t == 1:
            d = j
            break
        j += 1

    # performing encryption
    ct = (message ** e) % n
    print(f"Encrypted message is {ct}")
```

```
    # performing decryption
    mes = (ct ** d) % n
    print(f"Decrypted message is {mes}")

p=int(input("Enter the value of p: "))
q=int(input("Enter the value of q: "))
msg=int(input("Enter the message: "))
RSA(p,q,msg)
```

OUTPUT:



RESULT:

Thus, a python program is implemented to demonstrate RSA Algorithm.

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EXP NO: 2b
DATE:

DIFFIE HELMAN KEY EXCHANGE

AIM:

To write a python program to Diffie Helman Key Exchange.

ALGORITHM:

1.Agree on Public Parameters: Both parties agree on two publicly known numbers: a large prime number \(p \) (the modulus) and a primitive root modulo \(p \), denoted as \(g \).

2. Generate Private Keys:
- Each party independently selects a private key.
- Party A selects a private key \(a \), which is a randomly chosen integer within the range \(1 < a < p-1 \).
- Party B selects a private key \(b \), which is a randomly chosen integer within the range \(1 < b < p-1 \).

3. Compute Public Keys:
- Party A computes its public key \(A \) using the formula \(A = g^a \mod p \).
- Party B computes its public key \(B \) using the formula \(B = g^b \mod p \).

4. Exchange Public Keys:
- Party A sends its public key \(A \) to Party B.
- Party B sends its public key \(B \) to Party A.

5. Compute Shared Secret:
- Party A uses Party B’s public key \(B \) and its own private key \(a \) to compute the shared secret \(s \) using the formula \(s = B^a \mod p \).
- Party B uses Party A’s public key \(A \) and its own private key \(b \) to compute the shared secret \(s \) using the formula \(s = A^b \mod p \).

6.Use Shared Secret: The shared secret \(s \) can be used as a key for symmetric encryption, allowing Party A and Party B to securely communicate.

7. Ensure Security**: The security of the Diffie-Hellman key exchange relies on the difficulty of solving the discrete logarithm problem. Therefore, \(p \) and \(g \) should be chosen such that they provide a high level of security against potential attacks.

PROGRAM:

```
def prime_checker(p):
    # Checks If the number entered is a Prime Number or not
    if p < 1:
        return -1
    elif p > 1:
        if p == 2:
            return 1
        for i in range(2, p):
            if p % i == 0:
                return -1
            return 1
def primitive_check(g, p, L):
    # Checks If The Entered Number Is A Primitive Root Or Not
    for i in range(1, p):
        L.append(pow(g, i) % p)
    for i in range(1, p):
        if L.count(i) > 1:
            L.clear()
            return -1
        return 1
l = []
while 1:
    P = int(input("Enter P : "))
    if prime_checker(P) == -1:
        print("Number Is Not Prime, Please Enter Again!")
        continue
    break

while 1:
    G = int(input(f"Enter The Primitive Root Of {P} : "))
    if primitive_check(G, P, l) == -1:
        print(f"Number Is Not A Primitive Root Of {P}, Please Try Again!")
        continue
    break

# Private Keys
x1, x2 = int(input("Enter The Private Key Of User 1 : ")), int(
    input("Enter The Private Key Of User 2 : "))
```

```
while 1:
    if x1 >= P or x2 >= P:
        print(f"Private Key Of Both The Users Should Be Less Than {P}!")
        continue
    break
# Calculate Public Keys
y1, y2 = pow(G, x1) % P, pow(G, x2) % P
# Generate Secret Keys
k1, k2 = pow(y2, x1) % P, pow(y1, x2) % P
print(f"\nSecret Key For User 1 Is {k1}\nSecret Key For User 2 Is {k2}\n")
if k1 == k2:
    print("Keys Have Been Exchanged Successfully")
else:
    print("Keys Have Not Been Exchanged Successfully")
```

OUTPUT:

```
┌──(kali㉿kali)-[~/Documents/cnslab]
└─$ vi diffie.py

┌──(kali㉿kali)-[~/Documents/cnslab]
└─$ python3 diffie.py
Enter P : 23
Enter The Primitive Root Of 23 : 9
Number Is Not A Primitive Root Of 23, Please Try Again!
Enter The Primitive Root Of 23 : 3
Number Is Not A Primitive Root Of 23, Please Try Again!
Enter The Primitive Root Of 23 : 4
Number Is Not A Primitive Root Of 23, Please Try Again!
Enter The Primitive Root Of 23 : 5
Enter The Private Key Of User 1 : 4
Enter The Private Key Of User 2 : 3

Secret Key For User 1 Is 18
Secret Key For User 2 Is 18

Keys Have Been Exchanged Successfully
```

RESULT:

Thus, a python program has been implemented to demonstrate Diffie Hellman Key Exchange Algorithm.