Experiment No 6

Aim: Implementation of Diffie Hellman Key exchange algorithm.

Theory:

Diffie-Hellman algorithm:

The Diffie-Hellman algorithm is one of the most important algorithms used for establishing a shared secret. At the time of exchanging data over a public network, we can use the shared secret for secret communication. We use an elliptic curve for generating points and getting a secret key using the parameters.

1. We will take four variables, i.e., **P (prime), G (the primitive root of P),** and **a and b (private values)**.
2. The variables **P** and **G** both are publicly available. The sender selects a private value, either a or b, for generating a key to exchange publicly. The receiver receives the key, and that generates a secret key, after which the sender and receiver both have the same secret key to encrypt.

Step-by-Step explanation is as follows:

Alice	**Bob**
Public Keys available = P, G	Public Keys available = P, G
Private Key Selected = a	Private Key Selected = b
Key generated => x = G^a mod P	Key generated => y = G^b mod P
The exchange of generated keys takes place	
Key received = y	key received = x
Generated Secret Key => k_a = y^a mod P	Generated Secret Key => k_b = x^b mod P
Algebraically, it can be shown that- k_a = k_b	
Users now have a symmetric secret key to encrypt	

Example:

Step 1: Alice and Bob get public numbers P = 23, G = 9

Step 2: Alice selected a private key a = 4 and
Bob selected a private key b = 3

Step 3: Alice and Bob compute public values
Alice: x =(9^4 mod 23) = (6561 mod 23) = 6
Bob: y = (9^3 mod 23) = (729 mod 23) = 16

Step 4: Alice and Bob exchange public numbers

Step 5: Alice receives public key y =16 and
Bob receives public key x = 6

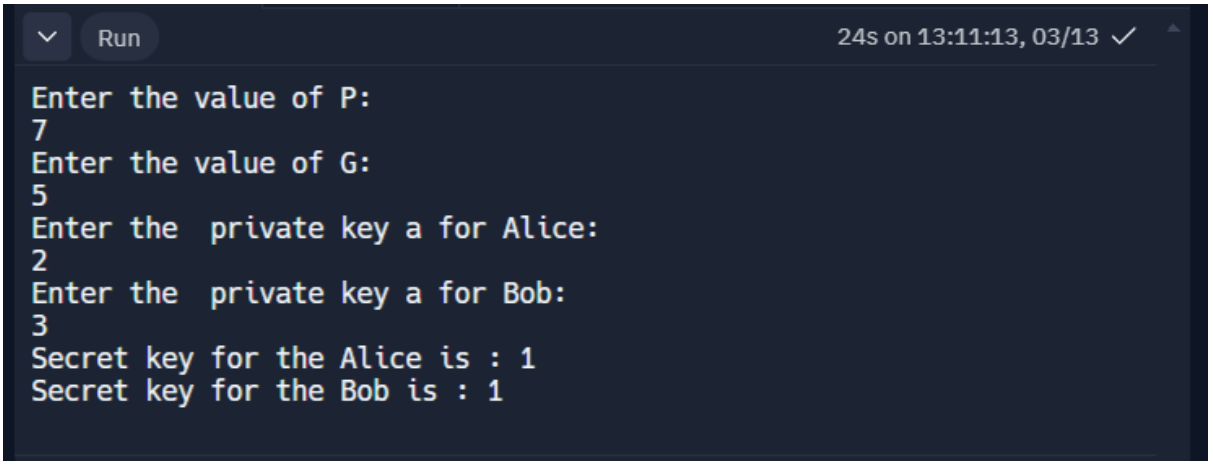
Step 6: Alice and Bob compute symmetric keys
Alice: ka = y^a mod p = 65536 mod 23 = 9
Bob: kb = x^b mod p = 216 mod 23 = 9

Step 7: 9 is the shared secret.

Code:

```
#include <cmath>
#include <iostream>
using namespace std;

long long int power(long long int a, long long int b, long long int P) {
  if (b == 1)
    return a;

  else
    return (((long long int)pow(a, b)) % P);
}

int main() {
  long long int P, G, x, a, y, b, ka, kb;

  cout << "Enter the value of P: " << endl;
  cin >> P;

  cout << "Enter the value of G: " << endl;
  cin >> G;

  cout << "Enter the  private key a for Alice: " << endl;
  cin >> a;

  x = power(G, a, P);

  cout << "Enter the  private key a for Bob: " << endl;
  cin >> b;

  y = power(G, b, P);

  ka = power(y, a, P);
  kb = power(x, b, P);
  cout << "Secret key for the Alice is : " << ka << endl;

  cout << "Secret key for the Bob is : " << kb << endl;

  return 0;
}
```

Output:


Run
24s on 13:11:13, 03/13
Enter the value of P:
7
Enter the value of G:
5
Enter the private key a for Alice:
2
Enter the private key a for Bob:
3
Secret key for the Alice is : 1
Secret key for the Bob is : 1