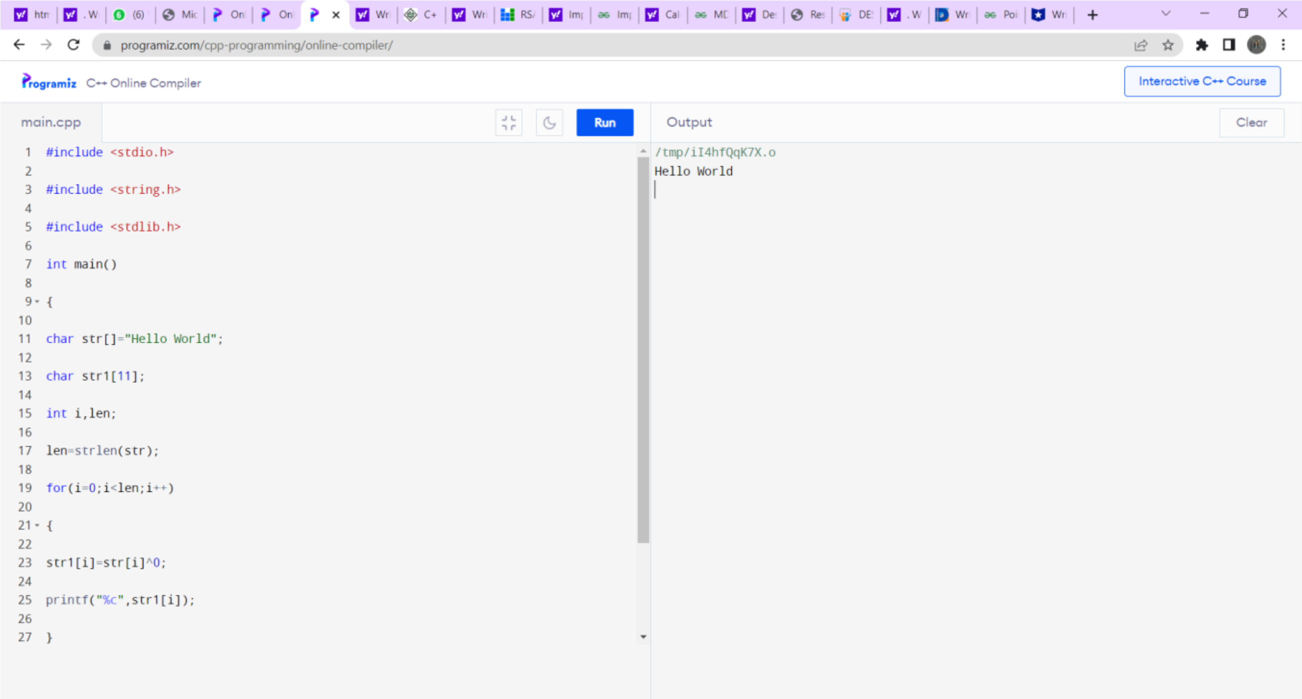
Experiment No 1

Write a Java/C/C++/Python program that contains a string (char pointer) with a value \Hello World’. The program should AND or and XOR each character in this string with 127 and display the result.

PROGRAM:

```
#include <stdio.h>

#include <string.h>

#include <stdlib.h>

int main()

{

char str[]="Hello World";

char str1[11];

int i,len;

len=strlen(str);

for(i=0;i<len;i++)

{

str1[i]=str[i]^0;

printf("%c",str1[i]);

}

printf("\n");

}
```

OUTPUT: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Interactive C++ Course
main.cpp
Run
Output
Clear

```
#include <stdio.h>

#include <string.h>

#include <stdlib.h>

int main()

{

char str[]="Hello World";

char str1[11];

int i,len;

len=strlen(str);

for(i=0;i<len;i++)

{

str1[i]=str[i]^0;

printf("%c",str1[i]);

}
```

```
/tmp/iI4hfQqK7X.o
Hello World
```

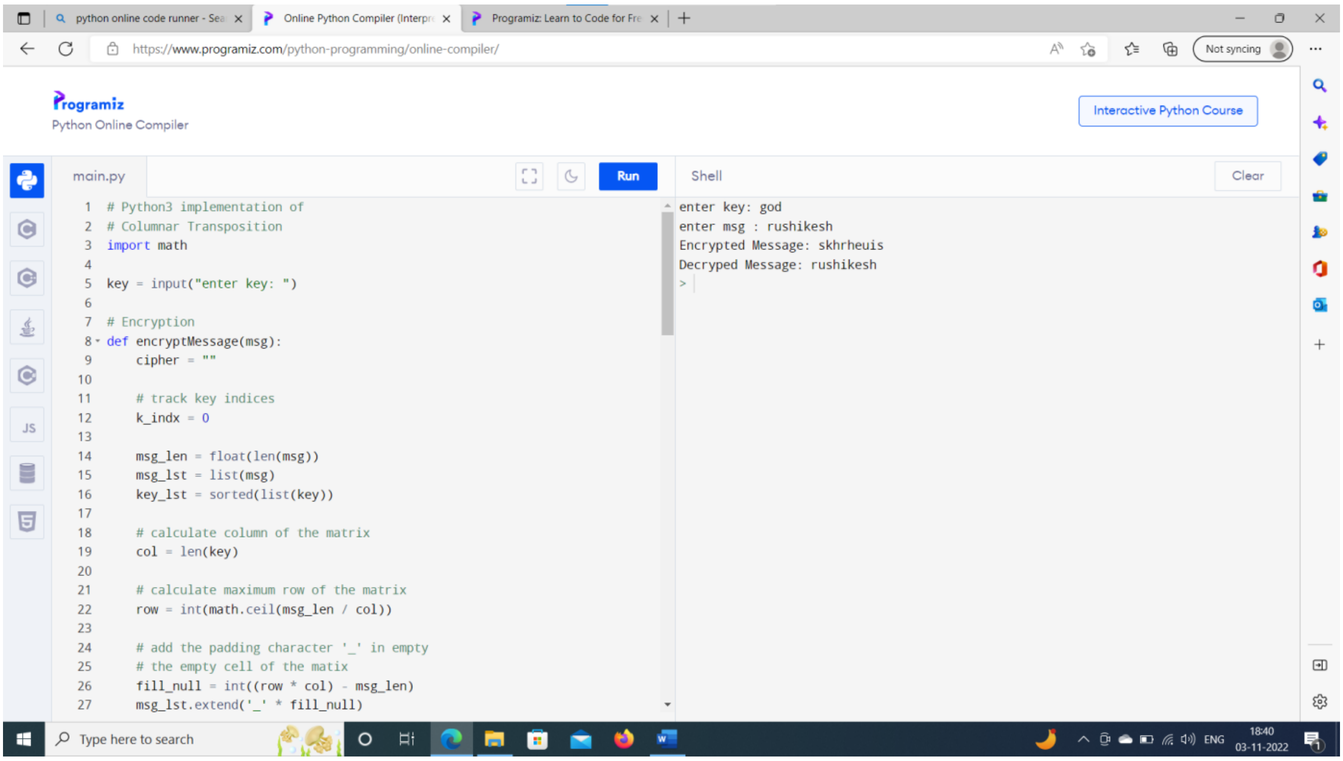
Experiment No 2

Write a Java/C/C++/Python program to perform encryption and decryption using the method of Transposition technique.

Program:

```
# Python3 implementation of

# Columnar Transposition

import math


key = input("enter key: ")


# Encryption

def encryptMessage(msg):

    cipher = ""


    k_indx = 0


    msg_len = float(len(msg))

    msg_lst = list(msg)

    key_lst = sorted(list(key))


    # calculate column of the matrix

    col = len(key)


    row = int(math.ceil(msg_len / col))


    fill_null = int((row * col) - msg_len)

    msg_lst.extend('_' * fill_null)

    matrix = [msg_lst[i: i + col]

            for i in range(0, len(msg_lst), col)]


    for _ in range(col):

        curr_idx = key.index(key_lst[k_indx])
        cipher += ''.join([row[curr_idx] for row in matrix])
        k_indx += 1

    return cipher

# Decryption
def decryptMessage(cipher):
    msg = ""

    k_indx = 0

    msg_indx = 0
    msg_len = float(len(cipher))
    msg_lst = list(cipher)

    col = len(key)

    row = int(math.ceil(msg_len / col))
    key_lst = sorted(list(key))

    dec_cipher = []
    for _ in range(row):
        dec_cipher += [[None] * col]

    for _ in range(col):
        curr_idx = key.index(key_lst[k_indx])

        for j in range(row):
            dec_cipher[j][curr_idx] = msg_lst[msg_indx]
            msg_indx += 1
        k_indx += 1
    # convert decrypted msg matrix into a string
    try:
        msg = ".join(sum(dec_cipher, []))
    except TypeError:
        raise TypeError("This program cannot","handle repeating words.")

    null_count = msg.count('_')

    if null_count > 0:
        return msg[: -null_count]

    return msg

# Driver Code
msg = input("enter msg : ")

cipher = encryptMessage(msg)
print("Encrypted Message: {}".format(cipher))

print("Decryped Message: {}".format(decryptMessage(cipher)))
```

Output:



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```
# Python3 implementation of
# Columnar Transposition
import math

key = input("enter key: ")

# Encryption
def encryptMessage(msg):
    cipher = ""

    # track key indices
    k_indx = 0

    msg_len = float(len(msg))
    msg_lst = list(msg)
    key_lst = sorted(list(key))

    # calculate column of the matrix
    col = len(key)

    # calculate maximum row of the matrix
    row = int(math.ceil(msg_len / col))

    # add the padding character '_' in empty
    # the empty cell of the matix
    fill_null = int((row * col) - msg_len)
    msg_lst.extend('_' * fill_null)
```

```
enter key: god
enter msg : rushikesh
Encrypted Message: skhrheuis
Decryped Message: rushikesh
>
```

Experiment No 3

Write a Java/C/C++/Python program to implement DES algorithm.

Program:

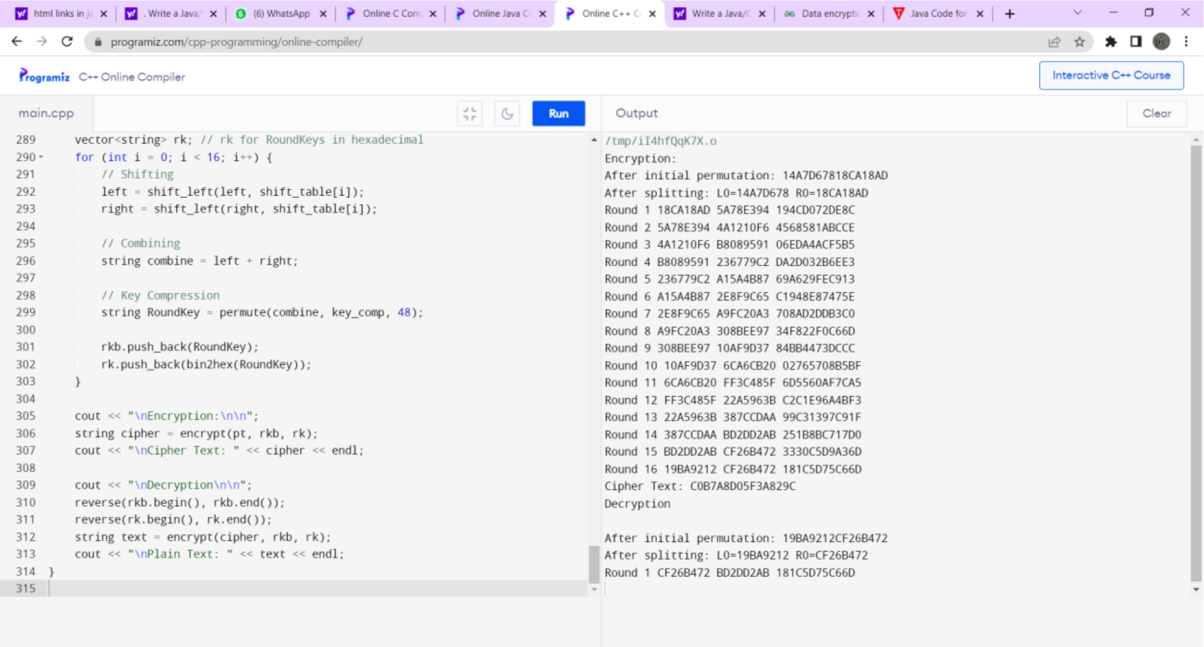
```
// C++ code for the above approach

#include <bits/stdc++.h>
using namespace std;
string hex2bin(string s)
{
	// hexadecimal to binary conversion
	unordered_map<char, string> mp;
	mp['0'] = "0000";
	mp['1'] = "0001";
	mp['2'] = "0010";
	mp['3'] = "0011";
	mp['4'] = "0100";
	mp['5'] = "0101";
	mp['6'] = "0110";
	mp['7'] = "0111";
	mp['8'] = "1000";
	mp['9'] = "1001";
	mp['A'] = "1010";
	mp['B'] = "1011";
	mp['C'] = "1100";
	mp['D'] = "1101";
	mp['E'] = "1110";
	mp['F'] = "1111";
	string bin = "";
	for (int i = 0; i < s.size(); i++) {
		bin += mp[s[i]];
	}
	return bin;
}
string bin2hex(string s)
```

```
{
    // binary to hexadecimal conversion
    unordered_map<string, string> mp;
    mp["0000"] = "0";
    mp["0001"] = "1";
    mp["0010"] = "2";
    mp["0011"] = "3";
    mp["0100"] = "4";
    mp["0101"] = "5";
    mp["0110"] = "6";
    mp["0111"] = "7";
    mp["1000"] = "8";
    mp["1001"] = "9";
    mp["1010"] = "A";
    mp["1011"] = "B";
    mp["1100"] = "C";
    mp["1101"] = "D";
    mp["1110"] = "E";
    mp["1111"] = "F";
    string hex = "";
    for (int i = 0; i < s.length(); i += 4) {
        string ch = "";
        ch += s[i];
        ch += s[i + 1];
        ch += s[i + 2];
        ch += s[i + 3];
        hex += mp[ch];
    }
    return hex;
}

string permute(string k, int* arr, int n)
{
    string per = "";
    for (int i = 0; i < n; i++) {
        per += k[arr[i] - 1];
    }
    return per;
}

string shift_left(string k, int shifts)
{
    string s = "";
    for (int i = 0; i < shifts; i++) {
        for (int j = 1; j < 28; j++) {
            s += k[j];
        }
        s += k[0];
        k = s;
        s = "";
    }
    return k;
}

string xor_(string a, string b)
{
    string ans = "";
    for (int i = 0; i < a.size(); i++) {
        if (a[i] == b[i]) {
            ans += "0";
        }
        else {
            ans += "1";
        }
    }
    return ans;
}
string encrypt(string pt, vector<string> rkb,
            vector<string> rk)
{
    // Hexadecimal to binary
    pt = hex2bin(pt);

    // Initial Permutation Table
    int initial_perm[64]
        = { 58, 50, 42, 34, 26, 18, 10, 2, 60, 52, 44,
            36, 28, 20, 12, 4, 62, 54, 46, 38, 30, 22,
            14, 6, 64, 56, 48, 40, 32, 24, 16, 8, 57,
            49, 41, 33, 25, 17, 9, 1, 59, 51, 43, 35,
            27, 19, 11, 3, 61, 53, 45, 37, 29, 21, 13,
            5, 63, 55, 47, 39, 31, 23, 15, 7 };
    // Initial Permutation
    pt = permute(pt, initial_perm, 64);
    cout << "After initial permutation: " << bin2hex(pt)
        << endl;

    // Splitting
    string left = pt.substr(0, 32);
    string right = pt.substr(32, 32);
    cout << "After splitting: L0=" << bin2hex(left)
        << " R0=" << bin2hex(right) << endl;

    // Expansion D-box Table
    int exp_d[48]
        = { 32, 1, 2, 3, 4, 5, 4, 5, 6, 7, 8, 9,
            8, 9, 10, 11, 12, 13, 12, 13, 14, 15, 16, 17,
            16, 17, 18, 19, 20, 21, 20, 21, 22, 23, 24, 25,
            24, 25, 26, 27, 28, 29, 28, 29, 30, 31, 32, 1 };

    // S-box Table
    int s[8][4][16] = {
        { 14, 4, 13, 1, 2, 15, 11, 8, 3, 10, 6, 12, 5,
9, 0, 7, 0, 15, 7, 4, 14, 2, 13, 1, 10, 6,
12, 11, 9, 5, 3, 8, 4, 1, 14, 8, 13, 6, 2,
11, 15, 12, 9, 7, 3, 10, 5, 0, 15, 12, 8, 2,
4, 9, 1, 7, 5, 11, 3, 14, 10, 0, 6, 13 },
{ 15, 1, 8, 14, 6, 11, 3, 4, 9, 7, 2, 13, 12,
0, 5, 10, 3, 13, 4, 7, 15, 2, 8, 14, 12, 0,
1, 10, 6, 9, 11, 5, 0, 14, 7, 11, 10, 4, 13,
1, 5, 8, 12, 6, 9, 3, 2, 15, 13, 8, 10, 1,
3, 15, 4, 2, 11, 6, 7, 12, 0, 5, 14, 9 },

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

// Straight Permutation Table
int per[32]
        = { 16, 7, 20, 21, 29, 12, 28, 17, 1, 15, 23,
                26, 5, 18, 31, 10, 2, 8, 24, 14, 32, 27,
                3, 9, 19, 13, 30, 6, 22, 11, 4, 25 };

cout << endl;
for (int i = 0; i < 16; i++) {
        // Expansion D-box
        string right_expanded = permute(right, exp_d, 48);

        // XOR RoundKey[i] and right_expanded
        string x = xor_(rkb[i], right_expanded);

        // S-boxes
        string op = "";
        for (int i = 0; i < 8; i++) {
                int row = 2 * int(x[i * 6] - '0')
                                + int(x[i * 6 + 5] - '0');
                int col = 8 * int(x[i * 6 + 1] - '0')
                                + 4 * int(x[i * 6 + 2] - '0')
                                + 2 * int(x[i * 6 + 3] - '0')
                                + int(x[i * 6 + 4] - '0');
                int val = s[i][row][col];
                op += char(val / 8 + '0');
        val = val % 8;
        op += char(val / 4 + '0');
        val = val % 4;
        op += char(val / 2 + '0');
        val = val % 2;
        op += char(val + '0');
    }
    // Straight D-box
    op = permute(op, per, 32);

    // XOR left and op
    x = xor_(op, left);

    left = x;

    // Swapper
    if (i != 15) {
        swap(left, right);
    }
    cout << "Round " << i + 1 << " " << bin2hex(left)
        << " " << bin2hex(right) << " " << rk[i]
        << endl;
}

// Combination
string combine = left + right;

// Final Permutation Table
int final_perm[64]
    = { 40, 8, 48, 16, 56, 24, 64, 32, 39, 7, 47,
        15, 55, 23, 63, 31, 38, 6, 46, 14, 54, 22,
        62, 30, 37, 5, 45, 13, 53, 21, 61, 29, 36,
        4, 44, 12, 52, 20, 60, 28, 35, 3, 43, 11,
        51, 19, 59, 27, 34, 2, 42, 10, 50, 18, 58,
                                26, 33, 1, 41, 9, 49, 17, 57, 25 };

            // Final Permutation
            string cipher
                        = bin2hex(permute(combine, final_perm, 64));
            return cipher;
}

// Driver code
int main()
{
            // pt is plain text
            string pt, key;
            /*cout<<"Enter plain text(in hexadecimal): ";
            cin>>pt;
            cout<<"Enter key(in hexadecimal): ";
            cin>>key;*/

            pt = "123456ABCD132536";
            key = "AABB09182736CCDD";
            // Key Generation

            // Hex to binary
            key = hex2bin(key);

            // Parity bit drop table
            int keyp[56]
                        = { 57, 49, 41, 33, 25, 17, 9, 1, 58, 50, 42, 34,
                                26, 18, 10, 2, 59, 51, 43, 35, 27, 19, 11, 3,
                                60, 52, 44, 36, 63, 55, 47, 39, 31, 23, 15, 7,
                                62, 54, 46, 38, 30, 22, 14, 6, 61, 53, 45, 37,
                                29, 21, 13, 5, 28, 20, 12, 4 };

            // getting 56 bit key from 64 bit using the parity bits
```

```
key = permute(key, keyp, 56); // key without parity

// Number of bit shifts
int shift_table[16] = { 1, 1, 2, 2, 2, 2, 2, 2,
                                                    1, 2, 2, 2, 2, 2, 2, 1 };

// Key- Compression Table
int key_comp[48] = { 14, 17, 11, 24, 1, 5, 3, 28,
                                            15, 6, 21, 10, 23, 19, 12, 4,
                                            26, 8, 16, 7, 27, 20, 13, 2,
                                            41, 52, 31, 37, 47, 55, 30, 40,
                                            51, 45, 33, 48, 44, 49, 39, 56,
                                            34, 53, 46, 42, 50, 36, 29, 32 };

// Splitting
string left = key.substr(0, 28);
string right = key.substr(28, 28);

vector<string> rkb; // rkb for RoundKeys in binary
vector<string> rk; // rk for RoundKeys in hexadecimal
for (int i = 0; i < 16; i++) {
        // Shifting
        left = shift_left(left, shift_table[i]);
        right = shift_left(right, shift_table[i]);

        // Combining
        string combine = left + right;

        // Key Compression
        string RoundKey = permute(combine, key_comp, 48);

        rkb.push_back(RoundKey);
        rk.push_back(bin2hex(RoundKey));
}
```

```
        cout << "\nEncryption:\n\n";
        string cipher = encrypt(pt, rkb, rk);
        cout << "\nCipher Text: " << cipher << endl;

        cout << "\nDecryption\n\n";
        reverse(rkb.begin(), rkb.end());
        reverse(rk.begin(), rk.end());
        string text = encrypt(cipher, rkb, rk);
        cout << "\nPlain Text: " << text << endl;
}
```

Output:



```
    vector<string> rk; // rk for RoundKeys in hexadecimal
    for (int i = 0; i < 16; i++) {
        // Shifting
        left = shift_left(left, shift_table[i]);
        right = shift_left(right, shift_table[i]);

        // Combining
        string combine = left + right;

        // Key Compression
        string RoundKey = permute(combine, key_comp, 48);

        rkb.push_back(RoundKey);
        rk.push_back(bin2hex(RoundKey));
    }

    cout << "\nEncryption:\n\n";
    string cipher = encrypt(pt, rkb, rk);
    cout << "\nCipher Text: " << cipher << endl;

    cout << "\nDecryption\n\n";
    reverse(rkb.begin(), rkb.end());
    reverse(rk.begin(), rk.end());
    string text = encrypt(cipher, rkb, rk);
    cout << "\nPlain Text: " << text << endl;
}
```

```
/tmp/iI4hfQqK7X.o
Encryption:
After initial permutation: 14A7D67818CA18AD
After splitting: L0=14A7D678 R0=18CA18AD
Round 1 18CA18AD 5A78E394 194CD072DE8C
Round 2 5A78E394 4A1210F6 4568581ABCCE
Round 3 4A1210F6 B8089591 06EDA4ACF5B5
Round 4 B8089591 236779C2 DA2D032B6EE3
Round 5 236779C2 A15A4B87 69A629FEC913
Round 6 A15A4B87 2E8F9C65 C1948E87475E
Round 7 2E8F9C65 A9FC20A3 708AD2DDB3C0
Round 8 A9FC20A3 308BEE97 34F822F0C66D
Round 9 308BEE97 10AF9D37 84BB4473DCCC
Round 10 10AF9D37 6CA6CB20 02765708B5BF
Round 11 6CA6CB20 FF3C485F 6D5560AF7CA5
Round 12 FF3C485F 22A5963B C2C1E96A4BF3
Round 13 22A5963B 387CCDAA 99C31397C91F
Round 14 387CCDAA BD2DD2AB 251B8BC717D0
Round 15 BD2DD2AB CF26B472 3330C5D9A36D
Round 16 19BA9212 CF26B472 181C5D75C66D
Cipher Text: C0B7A8D05F3A829C
Decryption

After initial permutation: 19BA9212CF26B472
After splitting: L0=19BA9212 R0=CF26B472
Round 1 CF26B472 BD2DD2AB 181C5D75C66D
```

Experiment No 4

Write a Java/C/C++/Python program to implement AES Algorithm.

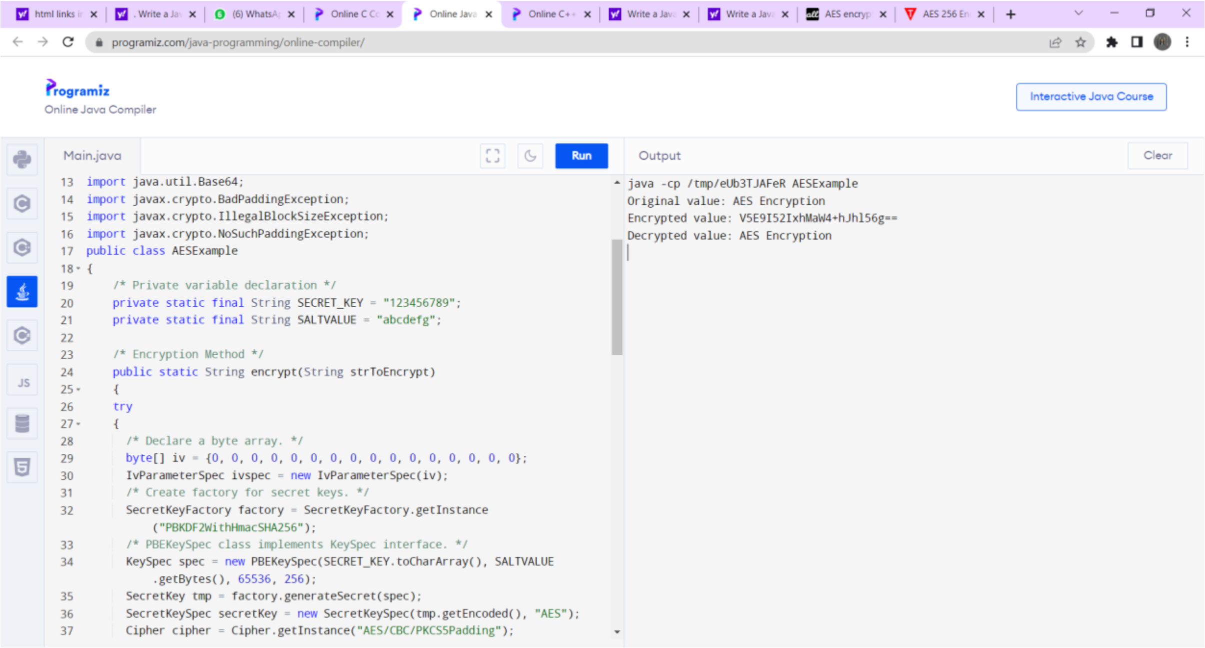
Program:

```
import javax.crypto.Cipher;
import javax.crypto.SecretKey;
import javax.crypto.SecretKeyFactory;
import javax.crypto.spec.IvParameterSpec;
import javax.crypto.spec.PBEKeySpec;
import javax.crypto.spec.SecretKeySpec;
import java.nio.charset.StandardCharsets;
import java.security.InvalidAlgorithmParameterException;
import java.security.InvalidKeyException;
import java.security.NoSuchAlgorithmException;
import java.security.spec.InvalidKeySpecException;
import java.security.spec.KeySpec;
import java.util.Base64;
import javax.crypto.BadPaddingException;
import javax.crypto.IllegalBlockSizeException;
import javax.crypto.NoSuchPaddingException;
public class AESExample
{
    /* Private variable declaration */
    private static final String SECRET_KEY = "123456789";
    private static final String SALTVALUE = "abcdefg";

    /* Encryption Method */
    public static String encrypt(String strToEncrypt)
    {
    try
    {
      /* Declare a byte array. */
      byte[] iv = {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0};
      IvParameterSpec ivspec = new IvParameterSpec(iv);
      /* Create factory for secret keys. */
      SecretKeyFactory factory = SecretKeyFactory.getInstance("PBKDF2WithHmacSHA256");
      /* PBEKeySpec class implements KeySpec interface. */
      KeySpec spec = new PBEKeySpec(SECRET_KEY.toCharArray(), SALTVALUE.getBytes(),
65536, 256);
      SecretKey tmp = factory.generateSecret(spec);
      SecretKeySpec secretKey = new SecretKeySpec(tmp.getEncoded(), "AES");
      Cipher cipher = Cipher.getInstance("AES/CBC/PKCS5Padding");
      cipher.init(Cipher.ENCRYPT_MODE, secretKey, ivspec);
      /* Retruns encrypted value. */
      return Base64.getEncoder()
.encodeToString(cipher.doFinal(strToEncrypt.getBytes(StandardCharsets.UTF_8)));
    }
    catch (InvalidAlgorithmParameterException | InvalidKeyException | NoSuchAlgorithmException |
InvalidKeySpecException | BadPaddingException | IllegalBlockSizeException |
NoSuchPaddingException e)
    {
      System.out.println("Error occured during encryption: " + e.toString());
    }
    return null;
    }

    /* Decryption Method */
    public static String decrypt(String strToDecrypt)
    {
    try
    {
      /* Declare a byte array. */
      byte[] iv = {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0};
      IvParameterSpec ivspec = new IvParameterSpec(iv);
      /* Create factory for secret keys. */
```

```
      SecretKeyFactory factory = SecretKeyFactory.getInstance("PBKDF2WithHmacSHA256");

      /* PBEKeySpec class implements KeySpec interface. */

      KeySpec spec = new PBEKeySpec(SECRET_KEY.toCharArray(), SALTVALUE.getBytes(),
65536, 256);

      SecretKey tmp = factory.generateSecret(spec);

      SecretKeySpec secretKey = new SecretKeySpec(tmp.getEncoded(), "AES");

      Cipher cipher = Cipher.getInstance("AES/CBC/PKCS5PADDING");

      cipher.init(Cipher.DECRYPT_MODE, secretKey, ivspec);

      /* Retruns decrypted value. */

      return new String(cipher.doFinal(Base64.getDecoder().decode(strToDecrypt)));

    }

    catch (InvalidAlgorithmParameterException | InvalidKeyException | NoSuchAlgorithmException |
InvalidKeySpecException | BadPaddingException | IllegalBlockSizeException |
NoSuchPaddingException e)

    {

      System.out.println("Error occured during decryption: " + e.toString());

    }

    return null;

    }

    /* Driver Code */

    public static void main(String[] args)

    {

        /* Message to be encrypted. */

        String originalval = "AES Encryption";

        /* Call the encrypt() method and store result of encryption. */

        String encryptedval = encrypt(originalval);

        /* Call the decrypt() method and store result of decryption. */

        String decryptedval = decrypt(encryptedval);

        /* Display the original message, encrypted message and decrypted message on the console. */

        System.out.println("Original value: " + originalval);

        System.out.println("Encrypted value: " + encryptedval);

        System.out.println("Decrypted value: " + decryptedval);

    }
```

```
}
```

Output:



```java
import java.util.Base64;
import javax.crypto.BadPaddingException;
import javax.crypto.IllegalBlockSizeException;
import javax.crypto.NoSuchPaddingException;
public class AESExample
{
    /* Private variable declaration */
    private static final String SECRET_KEY = "123456789";
    private static final String SALTVALUE = "abcdefg";

    /* Encryption Method */
    public static String encrypt(String strToEncrypt)
    {
    try
    {
      /* Declare a byte array. */
      byte[] iv = {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0};
      IvParameterSpec ivspec = new IvParameterSpec(iv);
      /* Create factory for secret keys. */
      SecretKeyFactory factory = SecretKeyFactory.getInstance
          ("PBKDF2WithHmacSHA256");
      /* PBEKeySpec class implements KeySpec interface. */
      KeySpec spec = new PBEKeySpec(SECRET_KEY.toCharArray(), SALTVALUE
          .getBytes(), 65536, 256);
      SecretKey tmp = factory.generateSecret(spec);
      SecretKeySpec secretKey = new SecretKeySpec(tmp.getEncoded(), "AES");
      Cipher cipher = Cipher.getInstance("AES/CBC/PKCS5Padding");
```

```
java -cp /tmp/eUb3TJAFeR AESExample
Original value: AES Encryption
Encrypted value: V5E9I52IxhMaW4+hJhl56g==
Decrypted value: AES Encryption
```

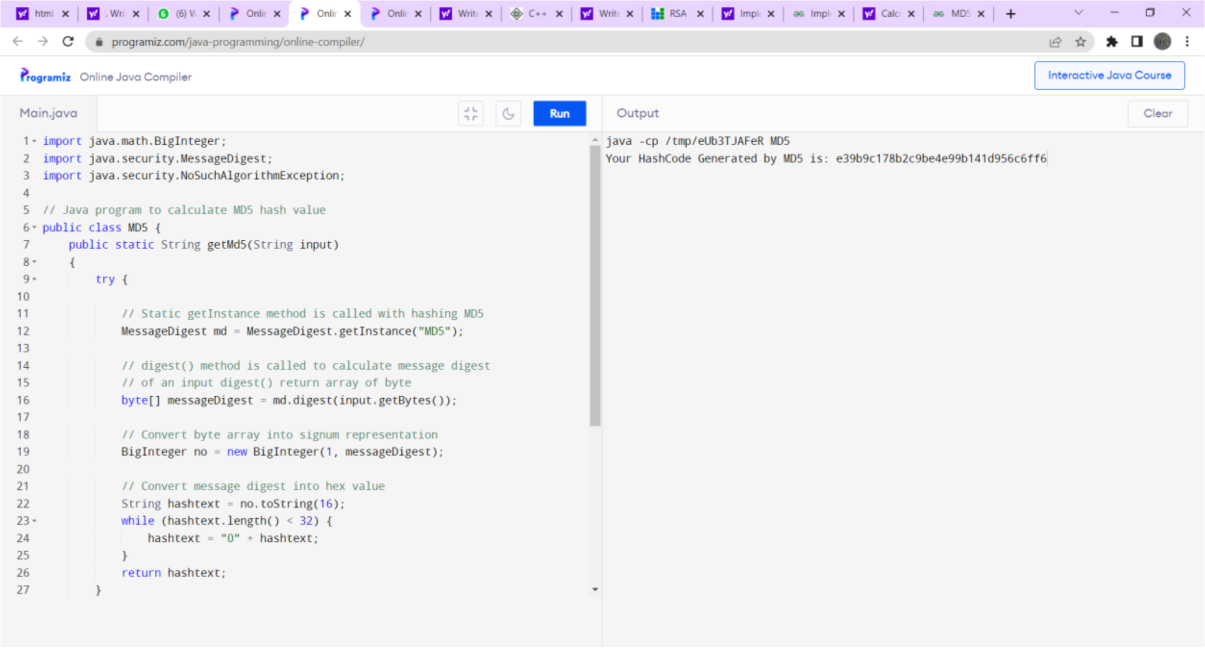
Experiment No 7

Calculate the message digest of a text using the MD5 algorithm in JAVA

Program:

```
import java.math.BigInteger;
import java.security.MessageDigest;
import java.security.NoSuchAlgorithmException;

// Java program to calculate MD5 hash value
public class MD5 {
        public static String getMd5(String input)
        {
                try {

                        // Static getInstance method is called with hashing MD5
                        MessageDigest md = MessageDigest.getInstance("MD5");

                        // digest() method is called to calculate message digest
                        // of an input digest() return array of byte
                        byte[] messageDigest = md.digest(input.getBytes());

                        // Convert byte array into signum representation
                        BigInteger no = new BigInteger(1, messageDigest);

                        // Convert message digest into hex value
                        String hashtext = no.toString(16);
                        while (hashtext.length() < 32) {
                                hashtext = "0" + hashtext;
                        }
                        return hashtext;
                }
                // For specifying wrong message digest algorithms
                catch (NoSuchAlgorithmException e) {
                        throw new RuntimeException(e);
                }
        }

        // Driver code
        public static void main(String args[]) throws NoSuchAlgorithmException
        {
                String s = "GeeksForGeeks";
                System.out.println("Your HashCode Generated by MD5 is: " + getMd5(s));
        }
}
```

Output:



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Main.java
Run
Output
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```
import java.math.BigInteger;
import java.security.MessageDigest;
import java.security.NoSuchAlgorithmException;

// Java program to calculate MD5 hash value
public class MD5 {
    public static String getMd5(String input)
    {
        try {

            // Static getInstance method is called with hashing MD5
            MessageDigest md = MessageDigest.getInstance("MD5");

            // digest() method is called to calculate message digest
            // of an input digest() return array of byte
            byte[] messageDigest = md.digest(input.getBytes());

            // Convert byte array into signum representation
            BigInteger no = new BigInteger(1, messageDigest);

            // Convert message digest into hex value
            String hashtext = no.toString(16);
            while (hashtext.length() < 32) {
                hashtext = "0" + hashtext;
            }
            return hashtext;
        }
```

```
java -cp /tmp/eUb3TJAFeR MD5
Your HashCode Generated by MD5 is: e39b9c178b2c9be4e99b141d956c6ff6
```

Experiment No 5

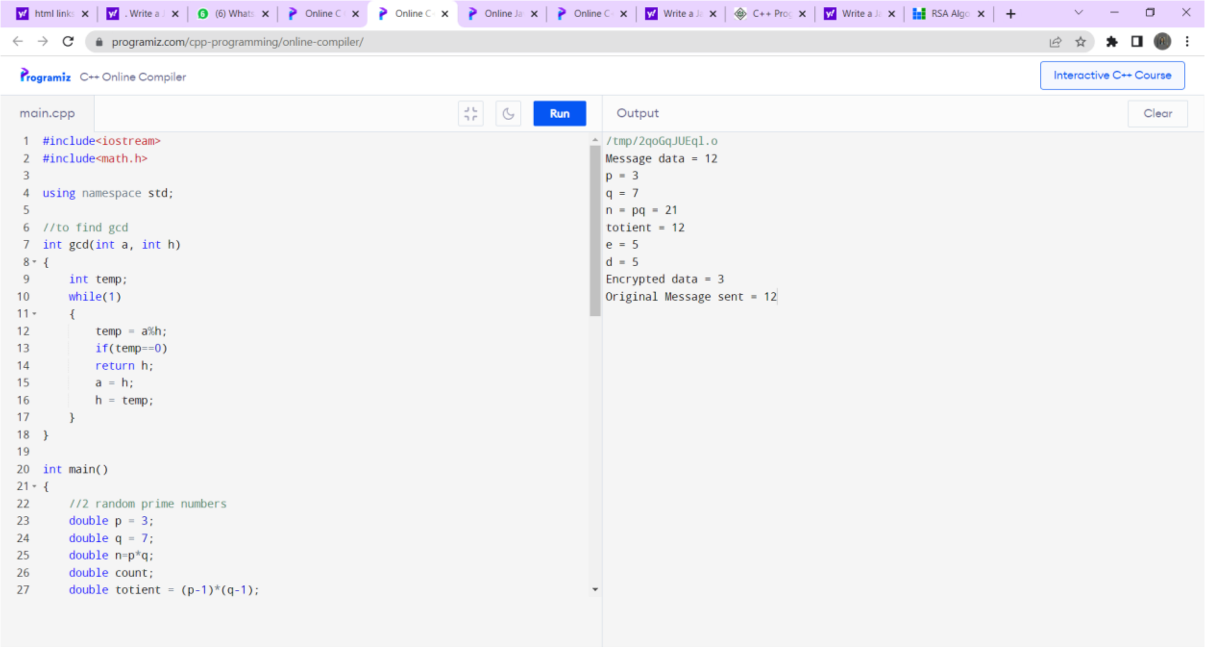
Write a Java/C/C++/Python program to implement RSA algorithm

Program:

```
//Program for RSA asymmetric cryptographic algorithm
//for demonstration values are relatively small compared to practical application

#include<iostream>
#include<math.h>

using namespace std;

//to find gcd
int gcd(int a, int h)
{
   int temp;
   while(1)
   {
      temp = a%h;
      if(temp==0)
      return h;
      a = h;
      h = temp;
   }
}

int main()
{
   //2 random prime numbers
   double p = 3;
   double q = 7;
   double n=p*q;
   double count;
   double totient = (p-1)*(q-1);

   //public key
   //e stands for encrypt
   double e=2;

   //for checking co-prime which satisfies e>1
   while(e<totient){
   count = gcd(e,totient);
   if(count==1)
      break;
   else
      e++;
   }

   //private key
   //d stands for decrypt
   double d;

   //k can be any arbitrary value
```

```
    double k = 2;

    //choosing d such that it satisfies d*e = 1 + k * totient
    d = (1 + (k*totient))/e;
    double msg = 12;
    double c = pow(msg,e);
    double m = pow(c,d);
    c=fmod(c,n);
    m=fmod(m,n);

    cout<<"Message data = "<<msg;
    cout<<"\n"<<"p = "<<p;
    cout<<"\n"<<"q = "<<q;
    cout<<"\n"<<"n = pq = "<<n;
    cout<<"\n"<<"totient = "<<totient;
    cout<<"\n"<<"e = "<<e;
    cout<<"\n"<<"d = "<<d;
    cout<<"\n"<<"Encrypted data = "<<c;
    cout<<"\n"<<"Original Message sent = "<<m;

    return 0;
}
```

Output:



```
#include<iostream>
#include<math.h>

using namespace std;

//to find gcd
int gcd(int a, int h)
{
    int temp;
    while(1)
    {
        temp = a%h;
        if(temp==0)
        return h;
        a = h;
        h = temp;
    }
}

int main()
{
    //2 random prime numbers
    double p = 3;
    double q = 7;
    double n=p*q;
    double count;
    double totient = (p-1)*(q-1);
```

```
/tmp/2qoGqJUEql.o
Message data = 12
p = 3
q = 7
n = pq = 21
totient = 12
e = 5
d = 5
Encrypted data = 3
Original Message sent = 12
```

Experiment No 6

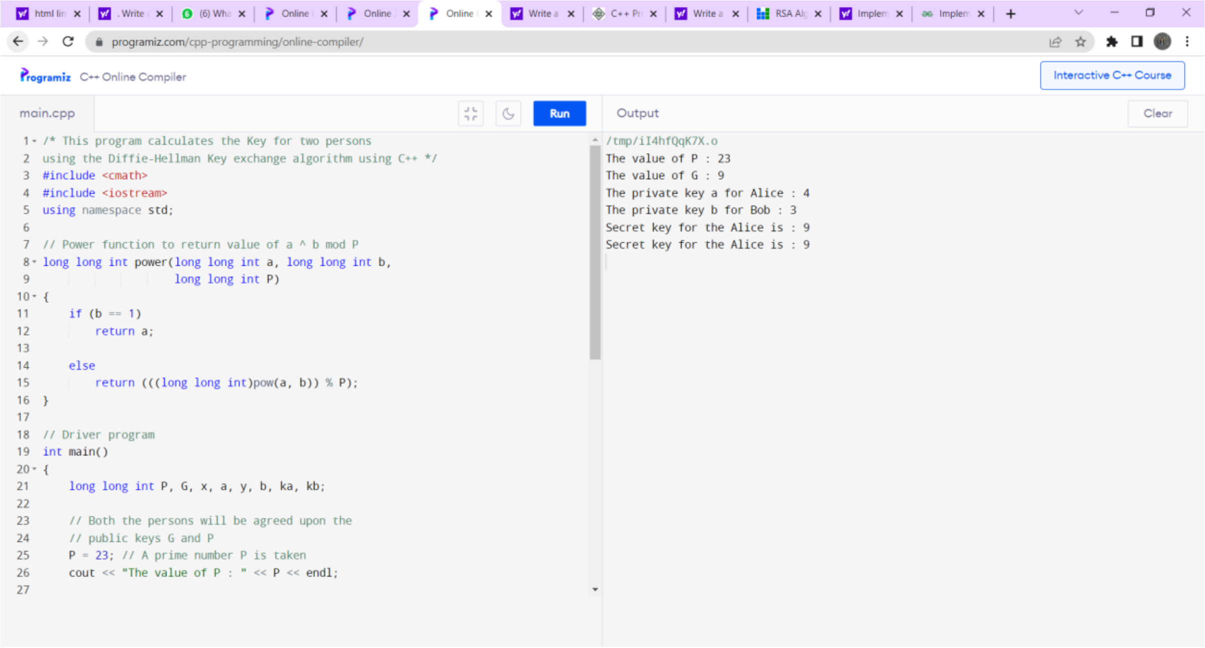
Implement the different Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as one of the parties (Alice) and the JavaScript application as other party (bob).

Program:

```
/* This program calculates the Key for two persons
using the Diffie-Hellman Key exchange algorithm using C++ */
#include <cmath>
#include <iostream>
using namespace std;

// Power function to return value of a ^ b mod P
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);
}

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

        // Both the persons will be agreed upon the
        // public keys G and P
        P = 23; // A prime number P is taken
        cout << "The value of P : " << P << endl;
```

```
	G = 9; // A primitive root for P, G is taken
	cout << "The value of G : " << G << endl;

	// Alice will choose the private key a
	a = 4; // a is the chosen private key
	cout << "The private key a for Alice : " << a << endl;

	x = power(G, a, P); // gets the generated key

	// Bob will choose the private key b
	b = 3; // b is the chosen private key
	cout << "The private key b for Bob : " << b << endl;

	y = power(G, b, P); // gets the generated key

	// Generating the secret key after the exchange
	// of keys
	ka = power(y, a, P); // Secret key for Alice
	kb = power(x, b, P); // Secret key for Bob
	cout << "Secret key for the Alice is : " << ka << endl;

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

	return 0;
}
```

Output:



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main.cpp
Run
Output
Clear

```cpp
/* This program calculates the Key for two persons
using the Diffie-Hellman Key exchange algorithm using C++ */
#include <cmath>
#include <iostream>
using namespace std;

// Power function to return value of a ^ b mod P
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);
}

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

    // Both the persons will be agreed upon the
    // public keys G and P
    P = 23; // A prime number P is taken
    cout << "The value of P : " << P << endl;

```

```
/tmp/iI4hfQqK7X.o
The value of P : 23
The value of G : 9
The private key a for Alice : 4
The private key b for Bob : 3
Secret key for the Alice is : 9
Secret key for the Alice is : 9
```