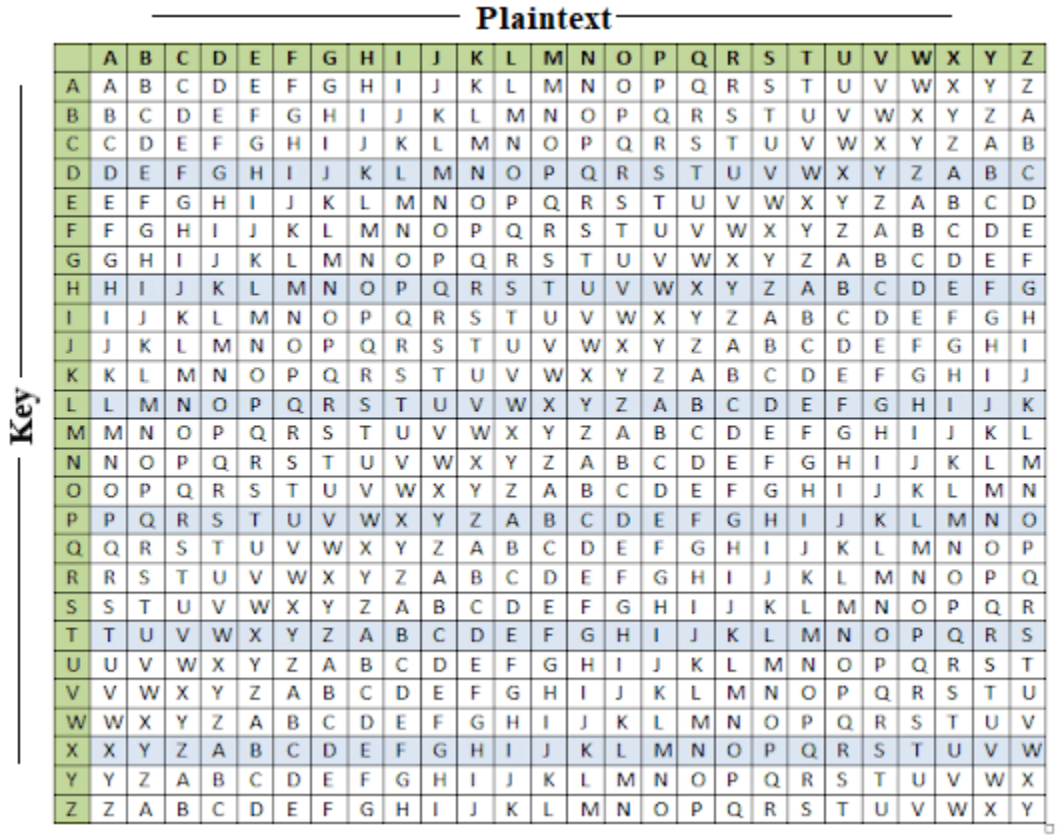
# Experiment No: 5

**Aim:** To study and implementation of Vigenère Cipher.

## Introduction:

The Vigenère Cipher is one type of a substitution cipher. It can be compared to Caesar Cipher. Though it is a interwoven Caesar Cipher. In Caesar Cipher, we used to add a key to every alphabet of a plaintext. But here we have a string as a key. So, we add key and plaintext. The output can also be given by using below matrix.



| Key \ Plaintext | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
| B | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | A |
| C | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | A | B |
| D | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | A | B | C |
| E | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | A | B | C | D |
| F | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | A | B | C | D | E |
| G | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | A | B | C | D | E | F |
| H | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | A | B | C | D | E | F | G |
| I | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | A | B | C | D | E | F | G | H |
| J | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | A | B | C | D | E | F | G | H | I |
| K | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | A | B | C | D | E | F | G | H | I | J |
| L | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | A | B | C | D | E | F | G | H | I | J | K |
| M | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | A | B | C | D | E | F | G | H | I | J | K | L |
| N | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | A | B | C | D | E | F | G | H | I | J | K | L | M |
| O | O | P | Q | R | S | T | U | V | W | X | Y | Z | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
| P | P | Q | R | S | T | U | V | W | X | Y | Z | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O |
| Q | Q | R | S | T | U | V | W | X | Y | Z | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P |
| R | R | S | T | U | V | W | X | Y | Z | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q |
| S | S | T | U | V | W | X | Y | Z | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R |
| T | T | U | V | W | X | Y | Z | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S |
| U | U | V | W | X | Y | Z | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T |
| V | V | W | X | Y | Z | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U |
| W | W | X | Y | Z | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V |
| X | X | Y | Z | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W |
| Y | Y | Z | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X |
| Z | Z | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y |

For example, “Hello world” is a plaintext and “begin” is the key. Then “Iirtb xsxtq” will be the output.

## Program (Source Code):

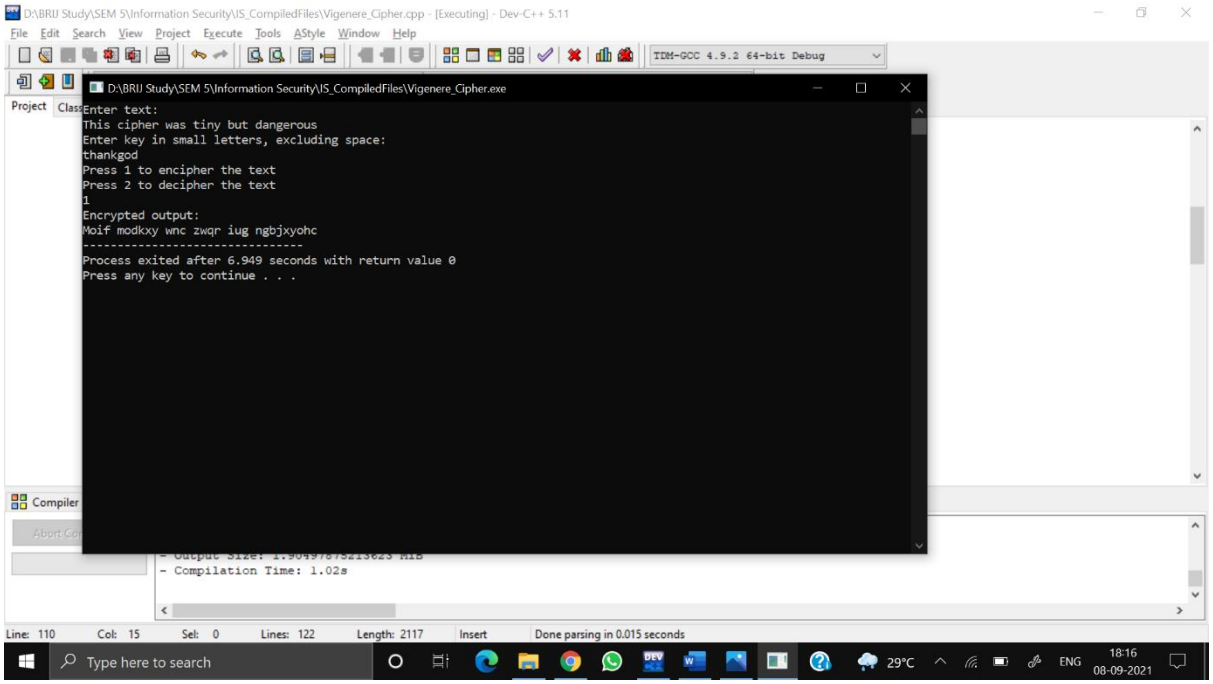
```
#include<iostream>
using namespace std;

int encry(string key, string text)
{
	string output = "";
	for(int i=0,j=0; i<text.length(); i++,j++)
	{
		if(int(text[i]) < 91 && text[i] != ' ')
```

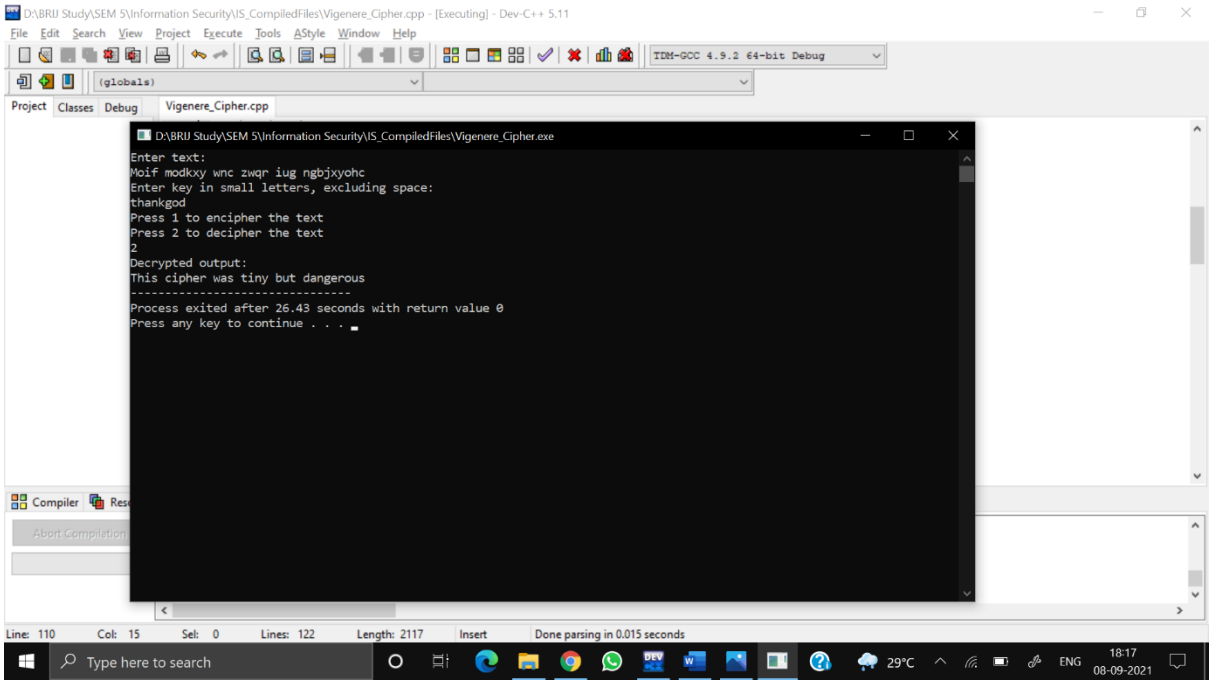
```
		{


			if((int(text[i]) + int(key[j]) - 97) > 90)
			{
				output += (int(text[i]) + int(key[j]) - 97 - 26);
			}
			else
			{
				output += (int(text[i]) + int(key[j]) - 97);
			}
		}

		else if(int(text[i]) > 96)
		{
			if((int(text[i]) + int(key[j]) - 97) < 123)
			{
				output += (int(text[i]) + int(key[j]) - 97);
			}
			else
			{
				output += (int(text[i]) + int(key[j]) - 97 - 26);
			}
		}

		else if(text[i] = ' ')
		{
			output += " ";
			j--;
		}

		if(j == key.length()-1) {j=-1;}
	}

	cout<<output;

	return 0;
}

int decry(string key, string text)
{
	string output = "";
	for(int i=0,j=0; i<text.length(); i++,j++)
	{
		if(int(text[i]) < 91 && text[i] != ' ')
		{
			if((int(text[i]) - int(key[j]) + 97) < 65)
			{
				output += (int(text[i]) - int(key[j]) + 97 + 26);
			}
```

```
                else
                {
                        output += (int(text[i]) - int(key[j]) + 97);
                }
        }

        else if(int(text[i]) > 96)
        {
                if((int(text[i]) - int(key[j]) + 97) > 96)
                {
                        output += (int(text[i]) - int(key[j]) + 97);
                }
                else
                {
                        output += (int(text[i]) - int(key[j]) + 97 + 26);
                }
        }

        else if(text[i] = ' ')
        {
                output += " ";
                j--;
        }

        if(j == key.length()-1) {j=-1;}
    }

    cout<<output;

    return 0;
}

int main()
{
    string key,text;
    cout<<"Enter text: "<<endl;
    getline(cin>>ws, text);
    cout<<"Enter key in small letters, excluding space: "<<endl;
    getline(cin>>ws, key);

    int choice;
    cout<<"Press 1 to encipher the text"<<endl;
    cout<<"Press 2 to decipher the text"<<endl;
    cin>>choice;

    switch(choice)
    {
    case 1:
        cout<<"Encrypted output:"<<endl;
        encry(key, text);
```

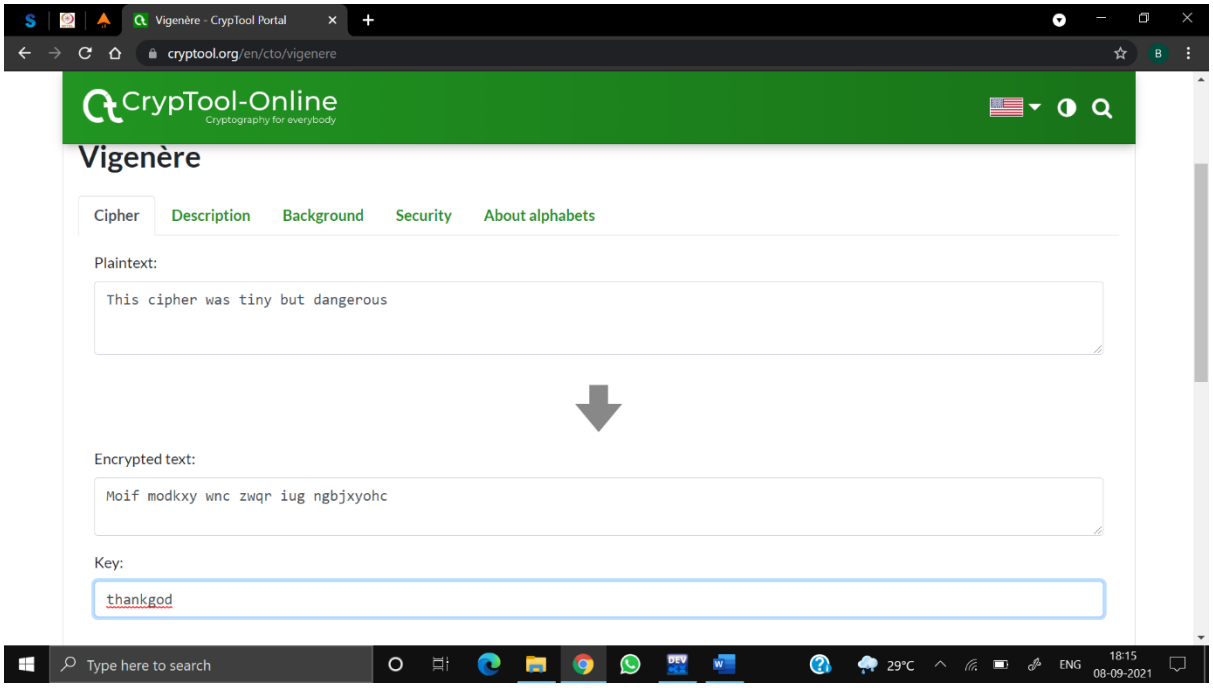
```
            break;

        case 2:
            cout<<"Decrypted output:"<<endl;
            decry(key, text);
            break;

        default:
            cout<<"Try again next time"<<endl;
        }

        return 0;
}
```

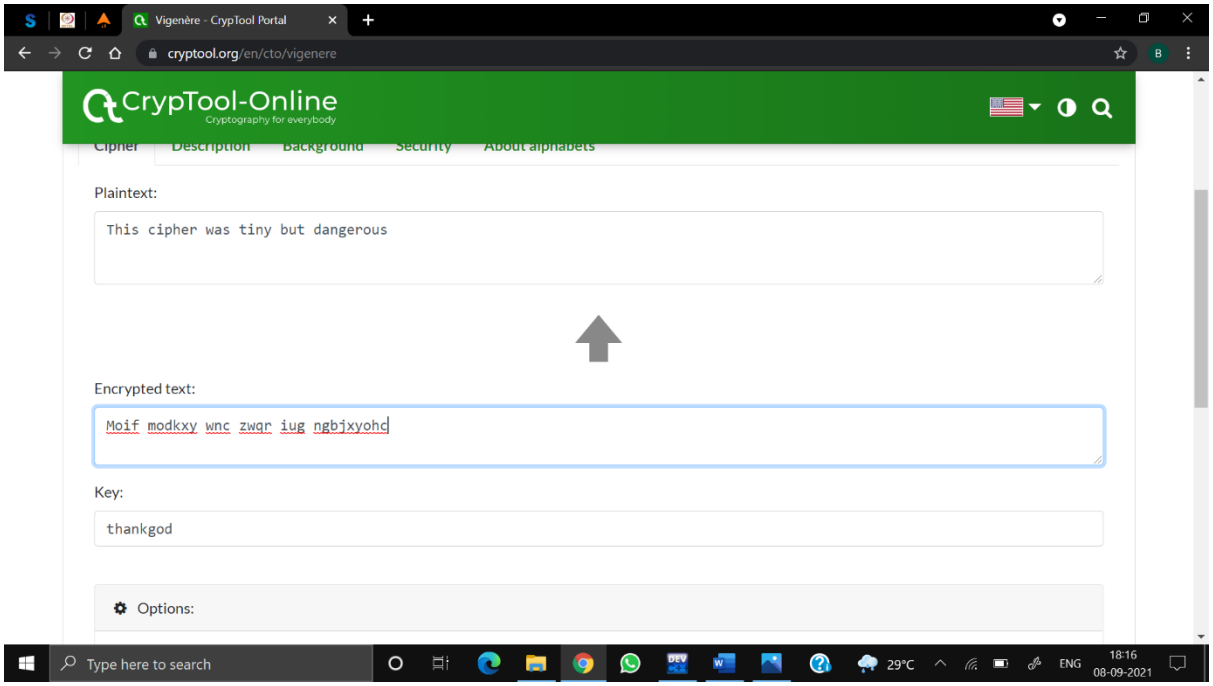
## Output (Program):






# Output (Cryptool):






## Cryptanalysis:

The idea behind the Vigenère cipher, like all other polyalphabetic ciphers, is to disguise the plaintext letter frequency to interfere with a straightforward application of frequency analysis. For instance, if P is the most frequent letter in a ciphertext whose plaintext is in English, one might suspect that P corresponds to E since E is the most frequently used letter in English. However, by using the Vigenère cipher, E can be enciphered as different ciphertext letters at different points in the message, which defeats simple frequency analysis.

The primary weakness of the Vigenère cipher is the repeating nature of its key. If a cryptanalyst correctly guesses the key's length, the cipher text can be treated as interwoven Caesar ciphers, which can easily be broken individually.

## Applications:

Vigenère cipher, type of substitution cipher used for data encryption in which the original plaintext structure is somewhat concealed in the ciphertext by using several different monoalphabetic substitution ciphers rather than just one; the code key specifies which particular substitution is to be employed for encrypting each plaintext symbol.

1. Such resulting ciphers, known generically as polyalphabetic, have a long history of usage.
2. The systems differ mainly in the way in which the key is used to choose among the collection of monoalphabetic substitution rules.
3. Application of Message Security Application Using Vigenère Cipher

## References:

1. https://www.cryptool.org/en/cto/vigenere
2. https://en.wikipedia.org/wiki/Vigen%C3%A8re_cipher

3. https://www.javatpoint.com/vigenere-cipher
4. https://static.javatpoint.com/tutorial/pwa/images/vigenere-cipher.png