CRYPTOGRAPHY AND NETWORK SECURITY LAB MANUAL

List of Programs:

1. Write a C program that contains a string (char pointer) with a value ‘Hello world’. The program should XOR each character in this string with 0 and displays the result.
2. Write a C 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.
3. Write a Java program to perform encryption and decryption using the following algorithms
    a. Ceaser cipher b. Substitution cipher c. Hill Cipher
4. Write a C/JAVA program to implement the DES algorithm logic.
5. Write a C/JAVA program to implement the Blowfish algorithm logic.
6. Write a C/JAVA program to implement the Rijndael algorithm logic.
7. Write the RC4 logic in Java Using Java cryptography; encrypt the text “Hello world” using Blowfish. Create your own key using Java key tool.
8. Write a Java program to implement RSA algorithm.
9. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript.
10. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.
11. Calculate the message digest of a text using the MD5 algorithm in JAVA.

1. Write a C program that contains a string (char pointer) with a value 'Hello world'. The program should XOR each character in this string with 0 and displays the result.

```
#include<stdlib.h>
#include<stdio.h>
#include<string.h>
void main()
{
        charstr[]="Hello World";
        char str1[11];
        inti,len;
        len=strlen(str);
        printf("string is\n");
        for(i=0;i<len;i++)
        {
                printf(" %c",str[i]);
        }
        printf("\nafter XOR\n");
        for(i=0;i<len;i++)
        {
                str1[i]=str[i]^1;
                printf("%c",str1[i]);
        }
        printf("\n");
}
```

Output:

string is
Hello world
after XOR
Hello world

2. Write a C 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 anddisplay the result.

```
#include <stdio.h>
#include<stdlib.h>
#include<string.h>
void main()
{
        charstr[]="Hello World";
        char str1[11];
        char str2[11];
        char str3[11];
        inti,len;
        len = strlen(str);
        printf("\n string2 is ");
        for(i=0;i<len;i++)
        {
                str2[i]=str[i];
                printf("%c",str2[i]);
        }
        printf("\nmodified string after AND is");
        for(i=0;i<len;i++)
        {
                str1[i] = str[i]&127;
                printf("%c",str1[i]);
        }
        printf("\n");
        printf("\n modified string after XOR is\n");
        for(i=0;i<len;i++)
        {
                str3[i] = str2[i]^127;
                printf("%c",str3[i]);
        }
        printf("\n");
}
```

Output:

```
string2 is Hello World
modified string after AND is
Hello World
modified string after XOR is
7-(
```

3. Write a Java program to perform encryption and decryption using the followingalgorithms

a. Ceaser cipher b. Substitution cipher c. Hill Cipher

a. Ceaser cipher

```
importjava.io.BufferedReader;
importjava.io.IOException;
importjava.io.InputStreamReader;
importjava.util.Scanner;
public class CeaserCipher
{
	static Scanner sc=new Scanner(System.in);
	staticBufferedReaderbr = new BufferedReader(new InputStreamReader(System.in));
	public static void main(String[] args) throws IOException
	{
		System.out.print("Enter any String: ");
		String str = br.readLine();
		System.out.print("\nEnter the Key: ");
		int key = sc.nextInt();
		String encrypted = encrypt(str, key);
		System.out.println("\nEncrypted String is: " +encrypted);
		String decrypted = decrypt(encrypted, key);
		System.out.println("\nDecrypted String is: " +decrypted);
		System.out.println("\n");
	}
	public static String encrypt(String str, int key)
	{
		String encrypted = "";
		for(inti = 0; i<str.length(); i++)
		{
			int c = str.charAt(i);
			if (Character.isUpperCase(c))
			{
				c = c + (key % 26);
				if (c > 'Z')
				c = c - 26;
			}
			else if (Character.isLowerCase(c))
			{
				c = c + (key % 26);
				if (c > 'z')
				c = c - 26;
			}
			encrypted += (char) c;
		}
		return encrypted;
	}
	public static String decrypt(String str, int key)
```

```
        {
                String decrypted = "";
                for(inti = 0; i<str.length(); i++)
                {
                        int c = str.charAt(i);
                        if (Character.isUpperCase(c))
                        {
                                c = c - (key % 26);
                                if (c < 'A')
                                c = c + 26;
                        }
                        else if (Character.isLowerCase(c))
                        {
                                c = c - (key % 26);
                                if (c < 'a')
                                c = c + 26;
                        }
                        decrypted += (char) c;
                }
                return decrypted;
        }
}
```

Output:

```
Enter any String: Hello
Enter the Key: 2
Encrypted String is: Jgnnq
Decrypted String is: Hello
```

b. Substitution cipher

```
import java.io.*;
importjava.util.*;
importjava.lang.*;
public class SubstitutionCipher
 {
        static Scanner sc = new Scanner(System.in);
        //static BufferedReaderbr = new BufferedReader(new InputStreamReader(System.in));
        public static void main(String[] args) throws IOException
        {
                String a = "abcdefghijklmnopqrstuvwxyz";
                String b = "zyxwvutsrqponmlkjihgfedcba";
                System.out.println("Enter any string: ");
                String str = sc.next();
                System.out.println("string is:"+str);
                String decrypt = "";
                String encrypt = "";
                /*intlen=str.length();
                System.out.println("string length of str is:"+len);*/
                charc,d;
```

```
                for(inti=0;i<str.length();i++)
                {
                        c = str.charAt(i);
                        int j = a.indexOf(c);
                        encrypt+= b.charAt(j);
                }
                System.out.println("The encrypted data is: " +encrypt);
                for(inti=0;i<encrypt.length();i++)
                {
                        d = encrypt.charAt(i);
                        int j = b.indexOf(d);
                        decrypt+= a.charAt(j);
                }
                System.out.println("The decrypted data is: " +decrypt);

        }
}
```

Output:

```
Enter any string:
hello
stringis:hello
The encrypted data is: svool
The decrypted data is: hello
```

c. Hill Cipher

```
import java.io.*;
importjava.util.*;
import java.io.*;
public class HillCipher
{
        static float[][] decrypt = new float[3][1];
        static float[][] a = new float[3][3];
        static float[][] b = new float[3][3];
        static float[][] mes = new float[3][1];
        static float[][] res = new float[3][1];
        staticBufferedReaderbr = new BufferedReader(new InputStreamReader(System.in));
        static Scanner sc = new Scanner(System.in);
        public static void main(String[] args) throws IOException
        {
                // TODO code application logic here
                getkeymes();
                for(inti=0;i<3;i++)
                for(int j=0;j<1;j++)
                for(int k=0;k<3;k++)
                {
                        res[i][j]=res[i][j]+a[i][k]*mes[k][j];
                }
```

```
        System.out.print("\nEncrypted string is : ");
        for(inti=0;i<3;i++)
        {
                System.out.print((char)(res[i][0]%26+97));
                res[i][0]=res[i][0];
        }
        inverse();
        for(inti=0;i<3;i++)
        for(int j=0;j<1;j++)
        for(int k=0;k<3;k++)
        {
                decrypt[i][j] = decrypt[i][j]+b[i][k]*res[k][j];
        }
        System.out.print("\nDecrypted string is : ");
        for(inti=0;i<3;i++)
        {
                System.out.print((char)(decrypt[i][0]%26+97));
        }
        System.out.print("\n");
}
public static void getkeymes() throws IOException
{
        System.out.println("Enter 3x3 matrix for key (It should be inversible): ");
        for(inti=0;i<3;i++)
        for(int j=0;j<3;j++)
        a[i][j] = sc.nextFloat();
        System.out.print("\nEnter a 3 letter string: ");
        String msg = br.readLine();
        for(inti=0;i<3;i++)
        mes[i][0] = msg.charAt(i)-97;
}
public static void inverse()
{
        floatp,q;
        float [][] c = a;
        for(inti=0;i<3;i++)
        for(int j=0;j<3;j++)
        {
                //a[i][j]=sc.nextFloat();
                if(i==j)
                        b[i][j]=1;
                else
                        b[i][j]=0;
        }
        for(int k=0;k<3;k++)
        {
                for(inti=0;i<3;i++)
                {
                        p = c[i][k];
                        q = c[k][k];
```

```
                                for(int j=0;j<3;j++)
                                {
                                        if(i!=k)
                                        {
                                                c[i][j] = c[i][j]*q-p*c[k][j];
                                                b[i][j] = b[i][j]*q-p*b[k][j];
                                        }
                                }
                        }
                }
                for(inti=0;i<3;i++)
                for(int j=0;j<3;j++)
                {
                        b[i][j] = b[i][j]/c[i][i];
                }
                System.out.println("");
                System.out.println("\nInverse Matrix is : ");
                for(inti=0;i<3;i++)
                {
                        for(int j=0;j<3;j++)
                                System.out.print(b[i][j] + " ");
                        System.out.print("\n");
                }
        }
}
```

Output:

```
Enter 3x3 matrix for key (It should be inversible):
6 24 1
13 16 10
20 17 15
Enter a 3 letter string: cat
Encrypted string is : fin
Inverse Matrix is :
0.15873016      -0.7777778      0.50793654
0.011337869     0.15873016      -0.106575966
-0.2244898      0.85714287      -0.48979592
Decrypted string is: cat
```

4. Write a C/JAVA program to implement the DES algorithm logic.

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
#include<malloc.h>
#include<stdlib.h>
#include<math.h>
void hex_to_bin(char *,char *);
char* bin_to_hex(char *);
void permutation(char *,char *);
void make_half(char *,char *,char *);
void single_shift(char *,char *);
void double_shift(char *,char *);
void make_key(char *,char *,char *);
void permutation_32(char *,char *);
void permutation_48(char *,char *);
void permutation_64(char *,char *,char *);
void des_round(char *,char *,char *,char *,char *,char *,char *);
void des_round_decry(char *,char *,char *,char *,char *,char *,char *);
void copy(char *,char *);
void permut_48(char *,char *);
void xor(char *,char *,char *);
void xor_32(char *,char *,char *);
void common_permutation(char *,char *);
void hex_to_plain(char *,char *,int);
intswitch_case(char );
char SB[32];
char *bin[]={"0000","0001","0010","0011","0100","0101","0110","0111","1000","1001",
"1010","1011","1100","1101","1110","1111"};
char hex[16]={'0','1','2','3','4','5','6','7','8','9','A','B','C','D','E','F'};
int PC1[8][7]={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};
int PC2[8][6]={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};
int IP[8][8]={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};
intE_bit[8][6]={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};
char *look_up[]={"00", "01","10","11"};
intsb_permutation[8][4]={ 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};
int s1[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};
int s2[4][16]={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};
int s3[4][16]={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};
int s4[4][16]={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};
```

```
int s5[4][16]={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};
int s6[4][16]={12,1,10,15,9,2,6,8,0,13,3,4,14,7,5,11,
                10,15,4,2,7,12,9,5,6,1,12,14,0,11,3,8,
                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};
int s7[4][16]={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};
int s8[4][16]={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};
intip_inverse[8][8]={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};
void main()
{
        char input[200],initial_hex[400];
        inti,j,k=0,len,r,x,m,temp;
        intd,e,f;
        char hex_arr[25][16];
        char input_hex[16],input_bin[64];
        char key_hex[16]={'1','3','3','4','5','7','7','9','9','B','B','C','D','F','F','1'};
        charkey_bin[64],key_PC1[56];
        char
ch,*decryption,*encryption,encryption_final[400],decryption_final_hex[400],decryption_final_plain
[200];
        char encrypted[64],decrypted[64],encry_permut[64],decry_permut[64];
        intlength,p=-1,q=-1;
        char
C0[28],D0[28],C1[28],D1[28],CD1[56],C2[28],D2[28],CD2[56],C3[28],D3[28],CD3[56],C4[28],D4
[28],CD4[56],C5[28],D5[28],CD5[56],C6[28],D6[28],CD6[56],C7[28],D7[28],CD7[56],C8[28],D8[
28],CD8[56],C9[28],D9[28],CD9[56],C10[28],D10[28],CD10[56],C11[28],D11[28],CD11[56],C12[
28],D12[28],CD12[56],C13[28],D13[28],CD13[56],C14[28],D14[28],CD14[56],C15[28],D15[28],C
D15[56],C16[28],D16[28],CD16[56];
```

```
char L0[32],R0[32],ER0[48];
char K1[48],L1[32],R1[32],ER1[48],F1[48],
K2[48],L2[32],R2[32],ER2[48],F2[48],K3[48],L3[32],R3[32],ER3[48],F3[48],K4[48],L4[32],R4[32
],ER4[48],F4[48],K5[48],L5[32],R5[32],ER5[48],F5[48],K6[48],L6[32],R6[32],ER6[48],F6[48],K7
[48],L7[32],R7[32],ER7[48],F7[48],K8[48],L8[32],R8[32],ER8[48],F8[48],K9[48],L9[32],R9[32],E
R9[48],F9[48],K10[48],L10[32],R10[32],ER10[48],F10[48],K11[48],L11[32],R11[32],ER11[48],F1
1[48],K12[48],L12[32],R12[32],ER12[48],F12[48],K13[48],L13[32],R13[32],ER13[48],F13[48],K1
4[48],L14[32],R14[32],ER14[48],F14[48],K15[48],L15[32],R15[32],ER15[48],F15[48],K16[48],L1
6[32],R16[32],ER16[48],F16[48];

clrscr();
/******************** Input Plain Text **********************/
printf(">Enter plain text : ");
gets(input);
len=strlen(input);
for(i=0;i<len;i++)
{
        while(input[i]!=0)
        {
                r=input[i]%16;
                input[i]=input[i]/16;
                if(r>9)
                {
                        x=r-10;
                        r=65+x;
                        initial_hex[k]=r;
                }
                else
                        initial_hex[k]=r+48;
                        k++;
        }
}
for(i=0;i<k;i=i+2)
{
        temp=initial_hex[i];
        initial_hex[i]=initial_hex[i+1];
        initial_hex[i+1]=temp;
}
d=k/16;
e=k%16;
f=0;
for(i=0;i<=d;i++)
{
        if(i<d)
```

```
        {
                for(j=0;j<=15;j++)
                hex_arr[i][j]=initial_hex[f++];
        }
        else if(k%16==0)
                break;
        else
        {
                for(j=0;j<=15;j++)
                {
                        if(j<e)
                                hex_arr[i][j]=initial_hex[f++];
                        else
                        {
                                hex_arr[i][j]='2';
                                hex_arr[i][++j]='0';
                        }
                }
        }
}
if(k%16!=0)
        d++;
/******************** Key in Binary form*****************/
hex_to_bin(key_hex,key_bin);
printf("\n>Key in Hexadecimal used for encryption : ");
for(i=0;i<16;i++)
printf("%c",key_hex[i]);
 for(m=0;m<d;m++)
 {
        for(i=0;i<16;i++)
        input_hex[i]=hex_arr[m][i];
/******************** Plain Text in Binary *****************/
hex_to_bin(input_hex,input_bin);
/******************** First Round of Permutation *****************/
permutation(key_bin,key_PC1);
make_half(key_PC1,C0,D0);
/******************** Shifting Begins *********************/
single_shift(C0,C1);
single_shift(D0,D1);
single_shift(C1,C2);
single_shift(D1,D2);
double_shift(C2,C3);
double_shift(D2,D3);
double_shift(C3,C4);
```

```
double_shift(D3,D4);
double_shift(C4,C5);
double_shift(D4,D5);
double_shift(C5,C6);
double_shift(D5,D6);
double_shift(C6,C7);
double_shift(D6,D7);
double_shift(C7,C8);
double_shift(D7,D8);
single_shift(C8,C9);
single_shift(D8,D9);
double_shift(C9,C10);
double_shift(D9,D10);
double_shift(C10,C11);
double_shift(D10,D11);
double_shift(C11,C12);
double_shift(D11,D12);
double_shift(C12,C13);
double_shift(D12,D13);
double_shift(C13,C14);
double_shift(D13,D14);
double_shift(C14,C15);
double_shift(D14,D15);
single_shift(C15,C16);
single_shift(D15,D16);

/******************** Shifting Ends ********************/
/*************** 16 Keys Generation Begins **************/
make_key(C1,D1,CD1);
permutation_48(CD1,K1);
make_key(C2,D2,CD2);
permutation_48(CD2,K2);
make_key(C3,D3,CD3);
permutation_48(CD3,K3);
make_key(C4,D4,CD4);
permutation_48(CD4,K4);
make_key(C5,D5,CD5);
permutation_48(CD5,K5);
make_key(C6,D6,CD6);
permutation_48(CD6,K6);
make_key(C7,D7,CD7);
permutation_48(CD7,K7);
make_key(C8,D8,CD8);
permutation_48(CD8,K8);
```

```
make_key(C9,D9,CD9);
permutation_48(CD9,K9);
make_key(C10,D10,CD10);
permutation_48(CD10,K10);
make_key(C11,D11,CD11);
permutation_48(CD11,K11);
make_key(C12,D12,CD12);
permutation_48(CD12,K12);
make_key(C13,D13,CD13);
permutation_48(CD13,K13);
make_key(C14,D14,CD14);
permutation_48(CD14,K14);
make_key(C15,D15,CD15);
permutation_48(CD15,K15);
make_key(C16,D16,CD16);
permutation_48(CD16,K16);

/*************** 16 Keys Generation Ends **************/
permutation_64(input_bin,L0,R0);
/************* 16 Rounds of Encryption *****************/
des_round(L1,R1,L0,R0,ER0,K1,F1);
des_round(L2,R2,L1,R1,ER1,K2,F2);
des_round(L3,R3,L2,R2,ER2,K3,F3);
des_round(L4,R4,L3,R3,ER3,K4,F4);
des_round(L5,R5,L4,R4,ER4,K5,F5);
des_round(L6,R6,L5,R5,ER5,K6,F6);
des_round(L7,R7,L6,R6,ER6,K7,F7);
des_round(L8,R8,L7,R7,ER7,K8,F8);
des_round(L9,R9,L8,R8,ER8,K9,F9);
des_round(L10,R10,L9,R9,ER9,K10,F10);
des_round(L11,R11,L10,R10,ER10,K11,F11);
des_round(L12,R12,L11,R11,ER11,K12,F12);
des_round(L13,R13,L12,R12,ER12,K13,F13);
des_round(L14,R14,L13,R13,ER13,K14,F14);
des_round(L15,R15,L14,R14,ER14,K15,F15);
des_round(L16,R16,L15,R15,ER15,K16,F16);
for(i=0;i<32;i++)
{
        encrypted[i]=R16[i];
        encrypted[i+32]=L16[i];
}
common_permutation(encrypted,encry_permut);
encryption=bin_to_hex(encry_permut);
for(i=0;i<16;i++)
```

```
{
        encryption_final[++p]=*(encryption+i);
}
/****************** 16 Rounds of Decryption ***************/
des_round_decry(L16,R16,L15,R15,ER15,K16,F16);
des_round_decry(L15,R15,L14,R14,ER14,K15,F15);
des_round_decry(L14,R14,L13,R13,ER13,K14,F14);
des_round_decry(L13,R13,L12,R12,ER12,K13,F13);
des_round_decry(L12,R12,L11,R11,ER11,K12,F12);
des_round_decry(L11,R11,L10,R10,ER10,K11,F11);
des_round_decry(L10,R10,L9,R9,ER9,K10,F10);
des_round_decry(L9,R9,L8,R8,ER8,K9,F9);
des_round_decry(L8,R8,L7,R7,ER7,K8,F8);
des_round_decry(L7,R7,L6,R6,ER6,K7,F7);
des_round_decry(L6,R6,L5,R5,ER5,K6,F6);
des_round_decry(L5,R5,L4,R4,ER4,K5,F5);
des_round_decry(L4,R4,L3,R3,ER3,K4,F4);
des_round_decry(L3,R3,L2,R2,ER2,K3,F3);
des_round_decry(L2,R2,L1,R1,ER1,K2,F2);
des_round_decry(L1,R1,L0,R0,ER0,K1,F1);
for(i=0;i<32;i++)
{
        decrypted[i]=L0[i];
        decrypted[i+32]=R0[i];
}
common_permutation(decrypted,decry_permut);
decryption=bin_to_hex(decry_permut);
for(i=0;i<16;i++)
{
        decryption_final_hex[++q]=*(decryption+i);
}
}
encryption_final[p+1]='\0';
printf("\n\n>Encrypted Output : ");
printf("%s",encryption_final);
decryption_final_hex[q+1]='\0';
printf("\n\n>Decrypted Output in Hexadecimal: ");
printf("%s",decryption_final_hex);
hex_to_plain(decryption_final_hex,decryption_final_plain,q+1);
printf("\n>Decrypted Output in Plain Text: ");
printf("%s\n",decryption_final_plain);
getch();
}
```

```
void hex_to_bin(char *input,char *in)
{
	short i,j,k,lim=0;
	for(i=0;i<16;i++)
	{
		for(j=0;j<16;j++)
		{
			if(*(input+i)==hex[j])
			{
				for(k=0;k<4;k++)
				{
					*(in+lim)=bin[j][k];
					lim++;
				}
			}
		}
	}
}

char* bin_to_hex(char *bit)
{
	char tmp[5],*out;
	short lim=0,i,j;
	out=(char*)malloc(16*sizeof(char));
	for(i=0;i<64;i=i+4)
	{
		tmp[0]=bit[i];
		tmp[1]=bit[i+1];
		tmp[2]=bit[i+2];
		tmp[3]=bit[i+3];
		tmp[4]='\0';
		for(j=0;j<16;j++)
		{
			if((strcmp(tmp,bin[j]))==0)
			{
				out[lim++]=hex[j];
				break;
			}
		}
	}
	out[lim]='\0';
	return out;
}
void hex_to_plain(char *in,char *out,int t)
```

```
{
	inti,j=0,z,sum;
	char temp[3];
	for(i=0;i<t;i=i+2)
	{
		sum=0;
		temp[0]=in[i];
		if(temp[0]>=65 && temp[0]<=71)
			z=switch_case(temp[0]);
		else
			z=temp[0]-48;
			sum=sum+z*16;
			temp[1]=in[i+1];
		if(temp[1]>=65 && temp[1]<=71)
			z=switch_case(temp[1]);
		else
			z=temp[1]-48;
			sum=sum+z*1;
			temp[2]='\0';
			*(out+j)=sum;
			j++;
	}
	*(out+j)='\0';
}

intswitch_case(char a)
{
	switch(a)
	{
		case 'A':
			return(10);
			break;
		case 'B':
			return(11);
			break;
		case 'C':
			return(12);
			break;
		case 'D':
			return(13);
			break;
		case 'E':
			return(14);
			break;
```

```
                case 'F':
                        return(15);
                        break;

        }
}
void permutation(char *key_bin,char *key_PC1)
{
        short i,j,k=0,temp;
        for(i=0;i<8;i++)
        {
                for(j=0;j<7;j++)
                {
                        temp=PC1[i][j]-1;
                        *(key_PC1+k)=*(key_bin+temp);
                        k++;
                }
        }
}
void make_half(char *key_PC1,char *a,char *b)
{
        inti,j=0;
        for(i=0;i<56;i++)
        {
                if(i<28)
                        *(a+i)=*(key_PC1+i);
                else
                {
                        *(b+j)=*(key_PC1+i);
                                j++;
                }
        }
}
void single_shift(char *p,char *q)
{
        inti;
        *(q+27)=*(p+0);
        for(i=0;i<27;i++)
                *(q+i)=*(p+(i+1));
}
void double_shift(char *p,char *q)
{
        inti;
        *(q+26)=*(p+0);
```

```
	*(q+27)=*(p+1);
	for(i=0;i<26;i++)
		*(q+i)=*(p+(i+2));
}
void make_key(char *a,char *b,char *c)
{
	inti;
	for(i=0;i<28;i++)
	*(c+i)=*(a+i);
	for(i=28;i<56;i++)
	*(c+i)=*(b+(i-28));
}
void permutation_48(char *CD,char *K)
{
	short i,j,m=0,temp;
	for(i=0;i<8;i++)
	{
		for(j=0;j<6;j++)
		{
			temp=PC2[i][j]-1;
			*(K+m)=*(CD+temp);
			m++;
		}
	}
}
void permutation_64(char *in,char *L,char *R)
{
	inti,j,m=0,temp;
	for(i=0;i<4;i++)
	{
		for(j=0;j<8;j++)
		{
			temp=IP[i][j]-1;
			*(L+m)=*(in+temp);
			m++;
		}
	}
	m=0;
	for(i=4;i<8;i++)
	{
		for(j=0;j<8;j++)
		{
			temp=IP[i][j]-1;
			*(R+m)=*(in+temp);
```

```
                        m++;
                }
        }

}
void des_round(char *L1,char *R1,char *L0,char *R0,char *ER0,char *K1,char *F1)
{
        char t[3],tp[5],f[32];
        inttemp,i,row,column,j,limit=0;
        copy(L1,R0);
        permut_48(R0,ER0);
        xor(K1,ER0,F1);
        for(i=0;i<48;i=i+6)
        {
                t[0]=F1[i];
                t[1]=F1[i+5];
                t[2]='\0';
                for(j=0;j<4;j++)
                {
                        if(strcmp(t,look_up[j])==0)
                        {
                                row=j;
                                break;
                        }
                }
                tp[0]=F1[i+1];
                tp[1]=F1[i+2];
                tp[2]=F1[i+3];
                tp[3]=F1[i+4];
                tp[4]='\0';
                for(j=0;j<16;j++)
                {
                        if(strcmp(tp,bin[j])==0)
                        {
                                column=j;
                                break;
                        }
                }
                switch(i)
                {
                        case 0:
                                temp=s1[row][column];
                                break;
                        case 6:
```

```
                        temp=s2[row][column];
                        break;
                case 12:
                        temp=s3[row][column];
                        break;
                case 18:
                        temp=s4[row][column];
                        break;
                case 24:
                        temp=s5[row][column];
                        break;
                case 30:
                        temp=s6[row][column];
                        break;
                case 36:
                        temp=s7[row][column];
                        break;
                case 42:
                        temp=s8[row][column];
                        break;
            }
            for(j=0;j<4;j++)
            {
                SB[limit]=bin[temp][j];
                limit++;
            }
        }
        SB[limit]='\0';
        permutation_32(SB,f);
        SB[0]='\0';
        xor_32(L0,f,R1);

}
void des_round_decry(char *L1,char *R1,char *L0,char *R0,char *ER0,char *K1,char *F1)
{
        char tp[5],f[32];
        short temp,i,row,column,j,limit=0;
        copy(L1,R0);
        permut_48(R0,ER0);
        xor(K1,ER0,F1);
        for(i=0;i<48;i=i+6)
        {
            tp[0]=F1[i];
            tp[1]=F1[i+5];
```

```
tp[2]='\0';
for(j=0;j<4;j++)
{
	if(strcmp(tp,look_up[j])==0)
	{
		row=j;
		break;
	}
}
tp[0]=F1[i+1];
tp[1]=F1[i+2];
tp[2]=F1[i+3];
tp[3]=F1[i+4];
tp[4]='\0';
for(j=0;j<16;j++)
{
	if(strcmp(tp,bin[j])==0)
	{
		column=j;
		break;
	}
}
switch(i)
{
	case 0:
		temp=s1[row][column];
		break;
	case 6:
		temp=s2[row][column];
		break;
	case 12:
		temp=s3[row][column];
		break;
	case 18:
		temp=s4[row][column];
		break;
	case 24:
		temp=s5[row][column];
		break;
	case 30:
		temp=s6[row][column];
		break;
	case 36:
		temp=s7[row][column];
```

```
                        break;
                case 42:
                        temp=s8[row][column];
                        break;
                }
                for(j=0;j<4;j++)
                {
                        SB[limit]=bin[temp][j];
                        limit++;
                }
        }
        SB[limit]='\0';
        permutation_32(SB,f);
        SB[0]='\0';
        xor_32(L0,f,R1);
}       void copy(char *L,char *R)
{
        inti;
        for(i=0;i<32;i++)
        *(L+i)=*(R+i);
}
void permut_48(char *R,char *ER)
{
        short i,j,m=0,temp;
        for(i=0;i<8;i++)
        {
                for(j=0;j<6;j++)
                {
                        temp=E_bit[i][j]-1;
                        *(ER+m)=*(R+temp);
                        m++;
                }
}
}
void xor(char *K,char *ER,char *F)
{
        inti,m=0;
        for(i=0;i<48;i++)
        {
                if((*(K+i)=='1' && *(ER+i)=='1') || (*(K+i)=='0' && *(ER+i)=='0'))
                {
                        *(F+m)='0';
                        m++;
                }
```

```
                else
                {
                        *(F+m)='1';
                        m++;
                }
        }
}
void xor_32(char *L0,char *f,char *R1)
{
        short i,m=0;
        for(i=0;i<32;i++)
        {
                if((*(L0+i)=='1' && *(f+i)=='1') || (*(L0+i)=='0' && *(f+i)=='0'))
                {
                        *(R1+m)='0';
                        m++;
                }
                else
                {
                        *(R1+m)='1';
                        m++;
                }
        }
}
void permutation_32(char *SB1,char *f)
{
        short i,j,m=0,temp;
        for(i=0;i<8;i++)
        {
                for(j=0;j<4;j++)
                {
                        temp=sb_permutation[i][j]-1;
                        *(f+m)=*(SB1+temp);
                        m++;
                }
        }
}
void common_permutation(char *in,char *out)
{
        short i,j,temp,m=0;
        for(i=0;i<8;i++)
        {
                for(j=0;j<8;j++)
                {
```

```
                    temp=ip_inverse[i][j]-1;
                    out[m]=in[temp];
                    m++;
                }
        }
}
```

Output:

```
Enter plain text: Madam
Key in hexadecimal used for encryption: 133457799BBCDFF1
Encrypted output: E5939798D7FB76E6
Decrypted output in hexadecimal: 6D6164616D202020
Decrypted output in plain text: madam
```

5. Write a C/JAVA program to implement the Blowfish algorithm logic.

```
import javax.crypto.Cipher;
import javax.crypto.KeyGenerator;
import javax.crypto.SecretKey;
import javax.swing.JOptionPane;
public class BlowFishCipher
{
	public static void main(String[] args) throws Exception
	{
		// create a key generator based upon the Blowfish cipher
		KeyGenerator keygenerator = KeyGenerator.getInstance("Blowfish");
		// create a key
		SecretKey secretkey = keygenerator.generateKey();
		// create a cipher based upon Blowfish
		Cipher cipher = Cipher.getInstance("Blowfish");
		// initialise cipher to with secret key
		cipher.init(Cipher.ENCRYPT_MODE, secretkey);
		// get the text to encrypt
		String inputText = JOptionPane.showInputDialog("Input your message: ");
		// encrypt message
		byte[] encrypted = cipher.doFinal(inputText.getBytes());
		// re-initialise the cipher to be in decrypt mode
		cipher.init(Cipher.DECRYPT_MODE, secretkey);
		// decrypt message
		byte[] decrypted = cipher.doFinal(encrypted);
		// and display the results
		JOptionPane.showMessageDialog(JOptionPane.getRootFrame(),
		"\nEncrypted text: " + new String(encrypted) + "\n" +
		"\nDecrypted text: " + new String(decrypted));
		System.exit(0);
	}
}
```

Output:

```
Input your message: Hello World
Encrypted text: ?:RW--???S
Decrypted text: Hello World
```

6. Write a C/JAVA program to implement the Rijndael algorithm logic.

```
#include<stdio.h>
#define Nb 4
int Nr=0;
int Nk=0;
unsigned char in[16], out[16], state[4][4];
unsigned char RoundKey[240];
unsigned char Key[32];

int getSBoxInvert(int num)
{
int rsbox[256] =

{ 0x52, 0x09, 0x6a, 0xd5, 0x30, 0x36, 0xa5, 0x38, 0xbf, 0x40, 0xa3, 0x9e, 0x81, 0xf3, 0xd7, 0xfb

, 0x7c, 0xe3, 0x39, 0x82, 0x9b, 0x2f, 0xff, 0x87, 0x34, 0x8e, 0x43, 0x44, 0xc4, 0xde, 0xe9, 0xcb

, 0x54, 0x7b, 0x94, 0x32, 0xa6, 0xc2, 0x23, 0x3d, 0xee, 0x4c, 0x95, 0x0b, 0x42, 0xfa, 0xc3, 0x4e

, 0x08, 0x2e, 0xa1, 0x66, 0x28, 0xd9, 0x24, 0xb2, 0x76, 0x5b, 0xa2, 0x49, 0x6d, 0x8b, 0xd1, 0x25

, 0x72, 0xf8, 0xf6, 0x64, 0x86, 0x68, 0x98, 0x16, 0xd4, 0xa4, 0x5c, 0xcc, 0x5d, 0x65, 0xb6, 0x92

, 0x6c, 0x70, 0x48, 0x50, 0xfd, 0xed, 0xb9, 0xda, 0x5e, 0x15, 0x46, 0x57, 0xa7, 0x8d, 0x9d, 0x84

, 0x90, 0xd8, 0xab, 0x00, 0x8c, 0xbc, 0xd3, 0x0a, 0xf7, 0xe4, 0x58, 0x05, 0xb8, 0xb3, 0x45, 0x06

, 0xd0, 0x2c, 0x1e, 0x8f, 0xca, 0x3f, 0x0f, 0x02, 0xc1, 0xaf, 0xbd, 0x03, 0x01, 0x13, 0x8a, 0x6b

, 0x3a, 0x91, 0x11, 0x41, 0x4f, 0x67, 0xdc, 0xea, 0x97, 0xf2, 0xcf, 0xce, 0xf0, 0xb4, 0xe6, 0x73

, 0x96, 0xac, 0x74, 0x22, 0xe7, 0xad, 0x35, 0x85, 0xe2, 0xf9, 0x37, 0xe8, 0x1c, 0x75, 0xdf, 0x6e

, 0x47, 0xf1, 0x1a, 0x71, 0x1d, 0x29, 0xc5, 0x89, 0x6f, 0xb7, 0x62, 0x0e, 0xaa, 0x18, 0xbe, 0x1b

, 0xfc, 0x56, 0x3e, 0x4b, 0xc6, 0xd2, 0x79, 0x20, 0x9a, 0xdb, 0xc0, 0xfe, 0x78, 0xcd, 0x5a, 0xf4

, 0x1f, 0xdd, 0xa8, 0x33, 0x88, 0x07, 0xc7, 0x31, 0xb1, 0x12, 0x10, 0x59, 0x27, 0x80, 0xec, 0x5f

, 0x60, 0x51, 0x7f, 0xa9, 0x19, 0xb5, 0x4a, 0x0d, 0x2d, 0xe5, 0x7a, 0x9f, 0x93, 0xc9, 0x9c, 0xef

, 0xa0, 0xe0, 0x3b, 0x4d, 0xae, 0x2a, 0xf5, 0xb0, 0xc8, 0xeb, 0xbb, 0x3c, 0x83, 0x53, 0x99, 0x61

, 0x17, 0x2b, 0x04, 0x7e, 0xba, 0x77, 0xd6, 0x26, 0xe1, 0x69, 0x14, 0x63, 0x55, 0x21, 0x0c, 0x7d };
return rsbox[num];
}
int getSBoxValue(int num)
{
int sbox[256] =   {
```

```
//0    1   2    3    4   5    6    7    8   9    A    B   C    D    E    F
0x63, 0x7c, 0x77, 0x7b, 0xf2, 0x6b, 0x6f, 0xc5, 0x30, 0x01, 0x67, 0x2b, 0xfe, 0xd7, 0xab, 0x76,
0xca, 0x82, 0xc9, 0x7d, 0xfa, 0x59, 0x47, 0xf0, 0xad, 0xd4, 0xa2, 0xaf, 0x9c, 0xa4, 0x72, 0xc0,
0xb7, 0xfd, 0x93, 0x26, 0x36, 0x3f, 0xf7, 0xcc, 0x34, 0xa5, 0xe5, 0xf1, 0x71, 0xd8, 0x31, 0x15,
0x04, 0xc7, 0x23, 0xc3, 0x18, 0x96, 0x05, 0x9a, 0x07, 0x12, 0x80, 0xe2, 0xeb, 0x27, 0xb2, 0x75,
0x09, 0x83, 0x2c, 0x1a, 0x1b, 0x6e, 0x5a, 0xa0, 0x52, 0x3b, 0xd6, 0xb3, 0x29, 0xe3, 0x2f, 0x84,
0x53, 0xd1, 0x00, 0xed, 0x20, 0xfc, 0xb1, 0x5b, 0x6a, 0xcb, 0xbe, 0x39, 0x4a, 0x4c, 0x58, 0xcf,
0xd0, 0xef, 0xaa, 0xfb, 0x43, 0x4d, 0x33, 0x85, 0x45, 0xf9, 0x02, 0x7f, 0x50, 0x3c, 0x9f, 0xa8,
0x51, 0xa3, 0x40, 0x8f, 0x92, 0x9d, 0x38, 0xf5, 0xbc, 0xb6, 0xda, 0x21, 0x10, 0xff, 0xf3, 0xd2,
0xcd, 0x0c, 0x13, 0xec, 0x5f, 0x97, 0x44, 0x17, 0xc4, 0xa7, 0x7e, 0x3d, 0x64, 0x5d, 0x19, 0x73,
0x60, 0x81, 0x4f, 0xdc, 0x22, 0x2a, 0x90, 0x88, 0x46, 0xee, 0xb8, 0x14, 0xde, 0x5e, 0x0b, 0xdb,
0xe0, 0x32, 0x3a, 0x0a, 0x49, 0x06, 0x24, 0x5c, 0xc2, 0xd3, 0xac, 0x62, 0x91, 0x95, 0xe4, 0x79,
0xe7, 0xc8, 0x37, 0x6d, 0x8d, 0xd5, 0x4e, 0xa9, 0x6c, 0x56, 0xf4, 0xea, 0x65, 0x7a, 0xae, 0x08,
0xba, 0x78, 0x25, 0x2e, 0x1c, 0xa6, 0xb4, 0xc6, 0xe8, 0xdd, 0x74, 0x1f, 0x4b, 0xbd, 0x8b, 0x8a,
0x70, 0x3e, 0xb5, 0x66, 0x48, 0x03, 0xf6, 0x0e, 0x61, 0x35, 0x57, 0xb9, 0x86, 0xc1, 0x1d, 0x9e,
0xe1, 0xf8, 0x98, 0x11, 0x69, 0xd9, 0x8e, 0x94, 0x9b, 0x1e, 0x87, 0xe9, 0xce, 0x55, 0x28, 0xdf,
0x8c, 0xa1, 0x89, 0x0d, 0xbf, 0xe6, 0x42, 0x68, 0x41, 0x99, 0x2d, 0x0f, 0xb0, 0x54, 0xbb, 0x16
};
return sbox[num];
}
int Rcon[255] =
{
0x8d, 0x01, 0x02, 0x04, 0x08, 0x10, 0x20, 0x40, 0x80, 0x1b, 0x36, 0x6c, 0xd8, 0xab, 0x4d, 0x9a,
0x2f, 0x5e, 0xbc, 0x63, 0xc6, 0x97, 0x35, 0x6a, 0xd4, 0xb3, 0x7d, 0xfa, 0xef, 0xc5, 0x91, 0x39,
0x72, 0xe4, 0xd3, 0xbd, 0x61, 0xc2, 0x9f, 0x25, 0x4a, 0x94, 0x33, 0x66, 0xcc, 0x83, 0x1d, 0x3a,
0x74, 0xe8, 0xcb, 0x8d, 0x01, 0x02, 0x04, 0x08, 0x10, 0x20, 0x40, 0x80, 0x1b, 0x36, 0x6c, 0xd8,
0xab, 0x4d, 0x9a, 0x2f, 0x5e, 0xbc, 0x63, 0xc6, 0x97, 0x35, 0x6a, 0xd4, 0xb3, 0x7d, 0xfa, 0xef,
0xc5, 0x91, 0x39, 0x72, 0xe4, 0xd3, 0xbd, 0x61, 0xc2, 0x9f, 0x25, 0x4a, 0x94, 0x33, 0x66, 0xcc,
```

```
0x83, 0x1d, 0x3a, 0x74, 0xe8, 0xcb, 0x8d, 0x01, 0x02, 0x04, 0x08, 0x10, 0x20, 0x40, 0x80, 0x1b,
0x36, 0x6c, 0xd8, 0xab, 0x4d, 0x9a, 0x2f, 0x5e, 0xbc, 0x63, 0xc6, 0x97, 0x35, 0x6a, 0xd4, 0xb3,
0x7d, 0xfa, 0xef, 0xc5, 0x91, 0x39, 0x72, 0xe4, 0xd3, 0xbd, 0x61, 0xc2, 0x9f, 0x25, 0x4a, 0x94,
0x33, 0x66, 0xcc, 0x83, 0x1d, 0x3a, 0x74, 0xe8, 0xcb, 0x8d, 0x01, 0x02, 0x04, 0x08, 0x10, 0x20,
0x40, 0x80, 0x1b, 0x36, 0x6c, 0xd8, 0xab, 0x4d, 0x9a, 0x2f, 0x5e, 0xbc, 0x63, 0xc6, 0x97, 0x35,
0x6a, 0xd4, 0xb3, 0x7d, 0xfa, 0xef, 0xc5, 0x91, 0x39, 0x72, 0xe4, 0xd3, 0xbd, 0x61, 0xc2, 0x9f,
0x25, 0x4a, 0x94, 0x33, 0x66, 0xcc, 0x83, 0x1d, 0x3a, 0x74, 0xe8, 0xcb, 0x8d, 0x01, 0x02, 0x04,
0x08, 0x10, 0x20, 0x40, 0x80, 0x1b, 0x36, 0x6c, 0xd8, 0xab, 0x4d, 0x9a, 0x2f, 0x5e, 0xbc, 0x63,
0xc6, 0x97, 0x35, 0x6a, 0xd4, 0xb3, 0x7d, 0xfa, 0xef, 0xc5, 0x91, 0x39, 0x72, 0xe4, 0xd3, 0xbd,
0x61, 0xc2, 0x9f, 0x25, 0x4a, 0x94, 0x33, 0x66, 0xcc, 0x83, 0x1d, 0x3a, 0x74, 0xe8, 0xcb
};
void KeyExpansion()
{
        int i,j;
        unsigned char temp[4],k;
        // The first round key is the key itself.
        for(i=0;i<Nk;i++)
        {
                RoundKey[i*4]=Key[i*4];
                RoundKey[i*4+1]=Key[i*4+1];
                RoundKey[i*4+2]=Key[i*4+2];
                RoundKey[i*4+3]=Key[i*4+3];
        }
        // All other round keys are found from the previous round keys.
        while (i < (Nb * (Nr+1)))
        {
                for(j=0;j<4;j++)
                {
                        temp[j]=RoundKey[(i-1) * 4 + j];

                }
                if (i % Nk == 0)
                {
                // This function rotates the 4 bytes in a word to the left once.
                // [a0,a1,a2,a3] becomes [a1,a2,a3,a0]
                // Function RotWord()
                {
                        k = temp[0];
                        temp[0] = temp[1];
                        temp[1] = temp[2];
                        temp[2] = temp[3];
```

```
                temp[3] = k;
            }
            // SubWord() is a function that takes a four-byte input word and
            // applies the S-box to each of the four bytes to produce an output word.
            // Function Subword()
            {
                temp[0]=getSBoxValue(temp[0]);
                temp[1]=getSBoxValue(temp[1]);
                temp[2]=getSBoxValue(temp[2]);
                temp[3]=getSBoxValue(temp[3]);
            }
            temp[0] =  temp[0] ^ Rcon[i/Nk];
            }
            else if (Nk > 6 && i % Nk == 4)
            {
            // Function Subword()
            {
                temp[0]=getSBoxValue(temp[0]);
                temp[1]=getSBoxValue(temp[1]);
                temp[2]=getSBoxValue(temp[2]);
                temp[3]=getSBoxValue(temp[3]);
            }
        }
        RoundKey[i*4+0] = RoundKey[(i-Nk)*4+0] ^ temp[0];
        RoundKey[i*4+1] = RoundKey[(i-Nk)*4+1] ^ temp[1];
        RoundKey[i*4+2] = RoundKey[(i-Nk)*4+2] ^ temp[2];
        RoundKey[i*4+3] = RoundKey[(i-Nk)*4+3] ^ temp[3];
        i++;
        }
}
// This function adds the round key to state.
// The round key is added to the state by an XOR function.
void AddRoundKey(int round)
{
        int i,j;
        for(i=0;i<4;i++)
        {
            for(j=0;j<4;j++)
            {
                state[j][i] ^= RoundKey[round * Nb * 4 + i * Nb + j];
            }
        }
}
// The SubBytes Function Substitutes the values in the
// state matrix with values in an S-box.
void InvSubBytes()
{
        int i,j;
        for(i=0;i<4;i++)
        {
```

```
                for(j=0;j<4;j++)
                {
                        state[i][j] = getSBoxInvert(state[i][j]);
                }
        }
}
// The ShiftRows() function shifts the rows in the state to the left.
// Each row is shifted with different offset.
// Offset = Row number. So the first row is not shifted.
void InvShiftRows()
{
        unsigned char temp;
        // Rotate first row 1 columns to right
        temp=state[1][3];
        state[1][3]=state[1][2];
        state[1][2]=state[1][1];
        state[1][1]=state[1][0];
        state[1][0]=temp;
        // Rotate second row 2 columns to right
        temp=state[2][0];
        state[2][0]=state[2][2];
        state[2][2]=temp;
        temp=state[2][1];
        state[2][1]=state[2][3];
        state[2][3]=temp;
        // Rotate third row 3 columns to right
        temp=state[3][0];
        state[3][0]=state[3][1];
        state[3][1]=state[3][2];
        state[3][2]=state[3][3];
        state[3][3]=temp;
}
// xtime is a macro that finds the product of {02} and the argument to xtime modulo {1b}
#define xtime(x)   ((x<<1) ^ (((x>>7) & 1) * 0x1b))
// Multiplty is a macro used to multiply numbers in the field GF(2^8)
#define Multiply(x,y) (((y & 1) * x) ^ ((y>>1 & 1) * xtime(x)) ^ ((y>>2 & 1) * xtime(xtime(x))) ^
((y>>3 & 1) * xtime(xtime(xtime(x)))) ^ ((y>>4 & 1) * xtime(xtime(xtime(xtime(x))))))
// MixColumns function mixes the columns of the state matrix.
// The method used to multiply may be difficult to understand for beginners.
// Please use the references to gain more information.
void InvMixColumns()
{
        int i;
        unsigned char a,b,c,d;
        for(i=0;i<4;i++)
        {
                a = state[0][i];
                b = state[1][i];

                c = state[2][i];
```

```
                d = state[3][i];
        state[0][i] = Multiply(a, 0x0e) ^ Multiply(b, 0x0b) ^ Multiply(c, 0x0d) ^ Multiply(d, 0x09);
        state[1][i] = Multiply(a, 0x09) ^ Multiply(b, 0x0e) ^ Multiply(c, 0x0b) ^ Multiply(d, 0x0d);
        state[2][i] = Multiply(a, 0x0d) ^ Multiply(b, 0x09) ^ Multiply(c, 0x0e) ^ Multiply(d, 0x0b);
        state[3][i] = Multiply(a, 0x0b) ^ Multiply(b, 0x0d) ^ Multiply(c, 0x09) ^ Multiply(d, 0x0e);
        }
}
// InvCipher is the main function that decrypts the CipherText.
void InvCipher()
{
        int i,j,round=0;
        //Copy the input CipherText to state array.
        for(i=0;i<4;i++)
        {
                for(j=0;j<4;j++)
                {
                        state[j][i] = in[i*4 + j];
                }
        }
        AddRoundKey(Nr);
        for(round=Nr-1;round>0;round--)
        {
                InvShiftRows();
                InvSubBytes();
                AddRoundKey(round);
                InvMixColumns();
        }
        InvShiftRows();
        InvSubBytes();
        AddRoundKey(0);
        for(i=0;i<4;i++)
        {
                for(j=0;j<4;j++)
                {
                        out[i*4+j]=state[j][i];
                }
        }
}

void main()
{
        int i;
        unsigned char temp[32] = {0x00 ,0x01 ,0x02 ,0x03 ,0x04 ,0x05 ,0x06 ,0x07 ,0x08 ,0x09
,0x0a ,0x0b ,0x0c ,0x0d ,0x0e ,0x0f};
        unsigned char temp2[16]= {0x69 ,0xc4 ,0xe0 ,0xd8 ,0x6a ,0x7b ,0x04 ,0x30 ,0xd8 ,0xcd
,0xb7 ,0x80 ,0x70 ,0xb4 ,0xc5 ,0x5a};
        while(Nr!=128 && Nr!=192 && Nr!=256)
        {
                printf("Enter the length of Key(128, 192 or 256 only)");
                scanf("%d",&Nr);
```

```
        }
        Nk = Nr / 32;
        Nr = Nk + 6;
        for(i=0;i<Nk*4;i++)
        {
                Key[i]=temp[i];
                in[i]=temp2[i];
        }
        flushall();
        printf("Enter the Key in hexadecimal");
        for(i=0;i<Nk*4;i++)
        {
                scanf("%x",&Key[i]);
        }
        printf("Enter the CipherText in hexadecimal:");
        for(i=0;i<Nb*4;i++)
        {
                scanf("%x",&in[i]);
        }
        KeyExpansion();
        InvCipher();
        printf("\nText after decryption:\n");
        for(i=0;i<Nb*4;i++)
        {
                printf("\n %02x",out[i]);
        }
}
```

Output:

```
Enter the length of Key(128, 192 or 256 only) 128
Enter the Key in hexadecimal
12 13 32 df 5d 4e c6 21 43 23 54 65 e3 d4 ed a2
Enter the CipherText in hexadecimal:
aa a3 c4 5d f2 12 97 67 ee cf a5 64 76 23 12 54
Text after decryption:
ec 23 80 c2 d4 01 a9 d4 03 3e 62 aa 3a 7d c6 57
```

7. Write the RC4 logic in Java Using Java cryptography; encrypt the text “Hello world” using Blowfish. Create your own key using Java key tool.

```
import javax.swing.*;
import java.security.SecureRandom;
import javax.crypto.Cipher;
import javax.crypto.KeyGenerator;
import javax.crypto.SecretKey;
import javax.crypto.spec.SecretKeySpec;
import java.util.Random ;
class RC4
{
	byte[] skey = new byte[1000];
	String skeyString;
	static byte[] raw;
	String inputMessage,encryptedData,decryptedMessage;
	public RC4()
	{
		try
		{
			generateSymmetricKey();
			inputMessage=JOptionPane.showInputDialog(null,"Enter message to
encrypt");
			byte[] ibyte = inputMessage.getBytes();
			byte[] ebyte=encrypt(raw, ibyte);
			String encryptedData = new String(ebyte);
			System.out.println("Encrypted message "+encryptedData);
			//JOptionPane.showMessageDialog(null,"Encrypted Data
"+"\n"+encryptedData);
			byte[] dbyte= decrypt(raw,ebyte);
			String decryptedMessage = new String(dbyte);
			System.out.println("Decrypted message "+decryptedMessage);
			//JOptionPane.showMessageDialog(null,"Decrypted Data
"+"\n"+decryptedMessage);
		}
		catch(Exception e)
		{
			System.out.println(e);
		}
	}
	void generateSymmetricKey()
	{
		try
		{
			Random r = new Random();
			int num = r.nextInt(10000);
			String knum = String.valueOf(num);
			byte[] knumb = knum.getBytes();
			skey=getRawKey(knumb);
			skeyString = new String(skey);
			System.out.println("RC4 Symmetric key = "+skeyString);
		}
```

```
            catch(Exception e)
            {
                System.out.println(e);
            }
        }
        private static byte[] getRawKey(byte[] seed) throws Exception
        {
            KeyGenerator kgen = KeyGenerator.getInstance("RC4");
            SecureRandom sr = SecureRandom.getInstance("SHA1PRNG");
            sr.setSeed(seed);
            kgen.init(56, sr);
            SecretKey skey = kgen.generateKey();
            raw = skey.getEncoded();
            return raw;
        }
        private static byte[] encrypt(byte[] raw, byte[] clear) throws Exception
        {
            SecretKeySpec skeySpec = new SecretKeySpec(raw, "RC4");
            Cipher cipher = Cipher.getInstance("RC4");
            cipher.init(Cipher.ENCRYPT_MODE, skeySpec);
            byte[] encrypted = cipher.doFinal(clear);
            return encrypted;
        }
        private static byte[] decrypt(byte[] raw, byte[] encrypted) throws Exception
        {
            SecretKeySpec skeySpec = new SecretKeySpec(raw, "RC4");
            Cipher cipher = Cipher.getInstance("RC4");
            cipher.init(Cipher.DECRYPT_MODE, skeySpec);
            byte[] decrypted = cipher.doFinal(encrypted);
            return decrypted;
        }
        public static void main(String args[])
        {
            RC4 rc = new RC4();
        }
}
```

Output:

RC4 Symmetric key = #□.,2B*
Encrypted message |&□pj□O□#□□
Decrypted message Hello World

8. Write a Java program to implement RSA algorithm.

```
importjava.util.*;
class RSA
{
	publicstaticvoid main(String args[])
	 {
		 Scanner sc=newScanner(System.in);
		intp,q,n,z,d=0,e,i;
		System.out.println("Enter the number to be encrypted and decrypted");
		intmsg=sc.nextInt();
		doublec,msgback;
		System.out.println("Enter 1st prime number p");
		 p=sc.nextInt();
		System.out.println("Enter 2nd prime number q");
		 q=sc.nextInt();

		 n=p*q;
		 z=(p-1)*(q-1);
		System.out.println("the value of z = "+z);
		for(e=2;e<z;e++)
		 {
			if(gcd(e,z)==1)		// e is for public key exponent
			 {
				break;
			 }
		 }
		System.out.println("the value of e = "+e);
		for(i=0;i<=9;i++)
		 {
			int x=1+(i*z);
			if(x%e==0)	//d is for private key exponent
			 {
				 d=x/e;
				break;
			 }
		 }
		System.out.println("the value of d = "+d);
		 c=(Math.pow(msg,e))%n;
		System.out.println("Encrypted message is : -");
		System.out.println(c);
		msgback=(Math.pow(c,d))%n;
		System.out.println("Decrypted message is : -");
		System.out.println(msgback);
	}

	staticintgcd(int e, int z)
	 {
		if(e==0)
		return z;
		else
		returngcd(z%e,e);
```

```
        }
}
```

Output:

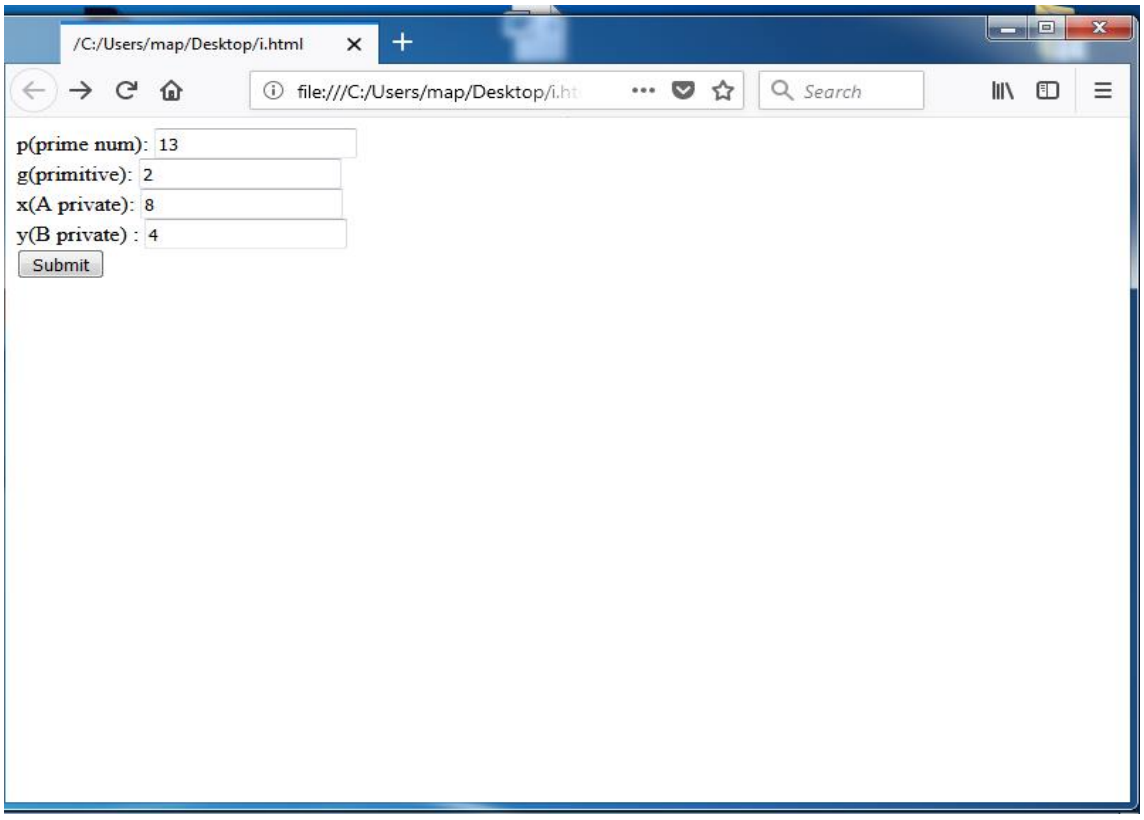
```
Enter the number to be encrypted and decrypted
4
Enter 1st prime number p
3
Enter 2nd prime number q
7
the value of z = 12
the value of e = 5
the value of d = 5
Encrypted message is : -
16.0
Decrypted message is : -
4.0
```

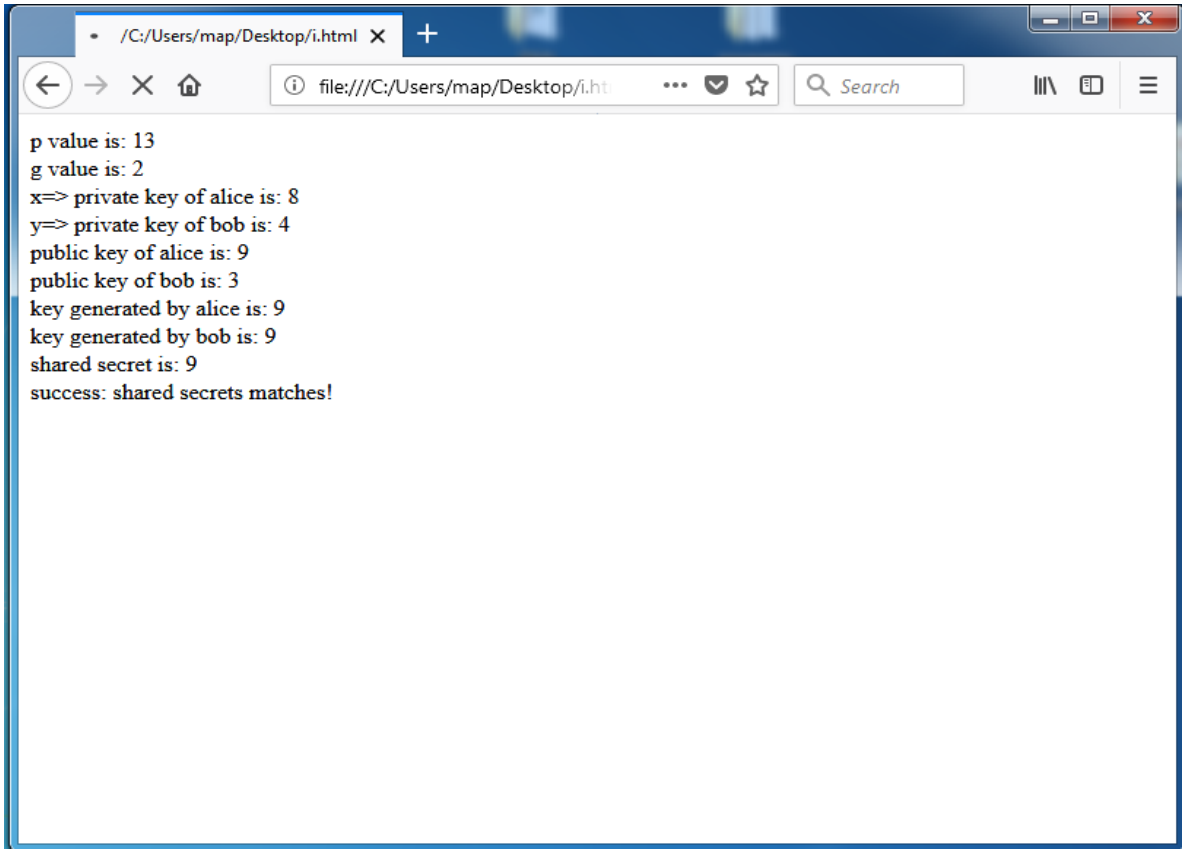
9. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript.

```
<html>

<head>
<script type="text/javascript">
	function test1()
	{
		var p = document.getElementById("p").value;
		var g = document.getElementById("g").value;
		var x = document.getElementById("x").value;
		var y = document.getElementById("y").value;
		document.write("p value is: "+p);
		document.write("<br>");

		document.write("g value is: "+g);
		document.write("<br>");

		document.write("x=> private key of alice is: "+x);
		document.write("<br>");


		document.write("y=> private key of bob is: "+y);
		document.write("<br>");
		var a = (Math.pow(g,x))%p;

		var b = (Math.pow(g,y))%p;

		var k1 = (Math.pow(b,x))%p;

		var k2 = (Math.pow(a,y))%p;

		var s = (Math.pow(g,(x*y)))%p;

		document.write("public key of alice is: "+a);

		document.write("<br>");
		document.write("public key of bob is: "+b);
		document.write("<br>");
		document.write(" key  generated by alice is: "+k1);
		document.write("<br>");
		document.write(" key  generated by bob is: "+k2);
		document.write("<br>");
		document.write("shared secret is: "+s);
		document.write("<br>");
		if ((k1 == s) && (k1 == k2))

			document.write("success: shared secrets matches! ");

		else
```

```
                document.write("error: shared secrets does not match");

        }
</script>
</head>

<body>

        p(prime num): <input type="text" id="p"></input><br>

        g(primitive): <input type="text" id="g"></input><br>
        x(A private): <input type="text" id="x"></input><br>
        y(B private) : <input type="text" id="y"></input><br>
        <button onclick="test1()">Submit</button><br>


</body>

</html>
```

Output:




/C:/Users/map/Desktop/i.html
file:///C:/Users/map/Desktop/i.ht
Search
p value is: 13
g value is: 2
x=> private key of alice is: 8
y=> private key of bob is: 4
public key of alice is: 9
public key of bob is: 3
key generated by alice is: 9
key generated by bob is: 9
shared secret is: 9
success: shared secrets matches!

10. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.

```
import java.security.*;
public class SHA1
{
	public static void main(String[] a)
	{
		try
		{
			MessageDigest md = MessageDigest.getInstance("SHA1");
			System.out.println("Message digest object info: ");
			System.out.println(" Algorithm = " +md.getAlgorithm());
			System.out.println(" Provider = " +md.getProvider());
			System.out.println(" ToString = " +md.toString());
			String input = "";
			md.update(input.getBytes());
			byte[] output = md.digest();
			System.out.println();
			System.out.println("SHA1(\""+input+"\") ="+bytesToHex(output));
			input = "abc";
			md.update(input.getBytes());
			output = md.digest();
			System.out.println();
			System.out.println("SHA1(\""+input+"\") = "+bytesToHex(output));
			input = "abcdefghijklmnopqrstuvwxyz";
			md.update(input.getBytes());
			output = md.digest();
			System.out.println();
			System.out.println("SHA1(\"" +input+"\") = "+bytesToHex(output));
			System.out.println("");
		}
		catch (Exception e)
		{
			System.out.println("Exception: " +e);
		}
	}
	Public static String bytesToHex(byte[] b)
	{
		charhexDigit[] = {'0', '1', '2', '3', '4', '5', '6','7', '8', '9', 'A', 'B', 'C', 'D', 'E', 'F'};
		StringBufferbuf = newStringBuffer();
		for (int j=0; j<b.length; j++)
		{
			buf.append(hexDigit[(b[j] >> 4) & 0x0f]);
			buf.append(hexDigit[b[j] & 0x0f]);
		 }
		return buf.toString();
	}
}
```

Output:

Message digest object info:
 Algorithm = SHA1
 Provider = SUN version 1.8
ToString = SHA1 Message Digest from SUN, <initialized>

SHA1("") =DA39A3EE5E6B4B0D3255BFEF95601890AFD80709

SHA1("abc") = A9993E364706816ABA3E25717850C26C9CD0D89D

SHA1("abcdefghijklmnopqrstuvwxyz") = 32D10C7B8CF96570CA04CE37F2A19D84240D3A89

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

```
import java.security.*;
public class MD5
{
	public static void main(String[] a)
	{
		try
		{
			MessageDigest md = MessageDigest.getInstance("MD5");
			System.out.println("Message digest object info: ");
			System.out.println(" Algorithm = " +md.getAlgorithm());
			System.out.println(" Provider = " +md.getProvider());
			System.out.println(" ToString = " +md.toString());
			String input = "";
			md.update(input.getBytes());
			byte[] output = md.digest();
			System.out.println();
			System.out.println("MD5(\""+input+"\") = " +bytesToHex(output));
			input = "abc";
			md.update(input.getBytes());
			output = md.digest();
			System.out.println();
			System.out.println("MD5(\""+input+"\") = " +bytesToHex(output));
			input = "abcdefghijklmnopqrstuvwxyz";
			md.update(input.getBytes());
			output = md.digest();
			System.out.println();
			System.out.println("MD5(\"" +input+"\") = " +bytesToHex(output));
			System.out.println("");
		}
		catch (Exception e)
		 {
			System.out.println("Exception: " +e);
		}
	}
	publicstatic String bytesToHex(byte[] b)
	{
		charhexDigit[] = {'0', '1', '2', '3', '4', '5', '6', '7', '8', '9', 'A', 'B', 'C', 'D', 'E', 'F'};
		StringBufferbuf = newStringBuffer();
		for (int j=0; j<b.length; j++)
		{
			buf.append(hexDigit[(b[j] >> 4) & 0x0f]);
			buf.append(hexDigit[b[j] & 0x0f]);
		}
		returnbuf.toString();
	}
}
```

Output:

```
Message digest object info:
 Algorithm = MD5
 Provider = SUN version 1.8
ToString = MD5 Message Digest from SUN, <initialized>

MD5("") = D41D8CD98F00B204E9800998ECF8427E

MD5("abc") = 900150983CD24FB0D6963F7D28E17F72

MD5("abcdefghijklmnopqrstuvwxyz") = C3FCD3D76192E4007DFB496CCA67E13B
```