AIM: Implement DES algorithm.

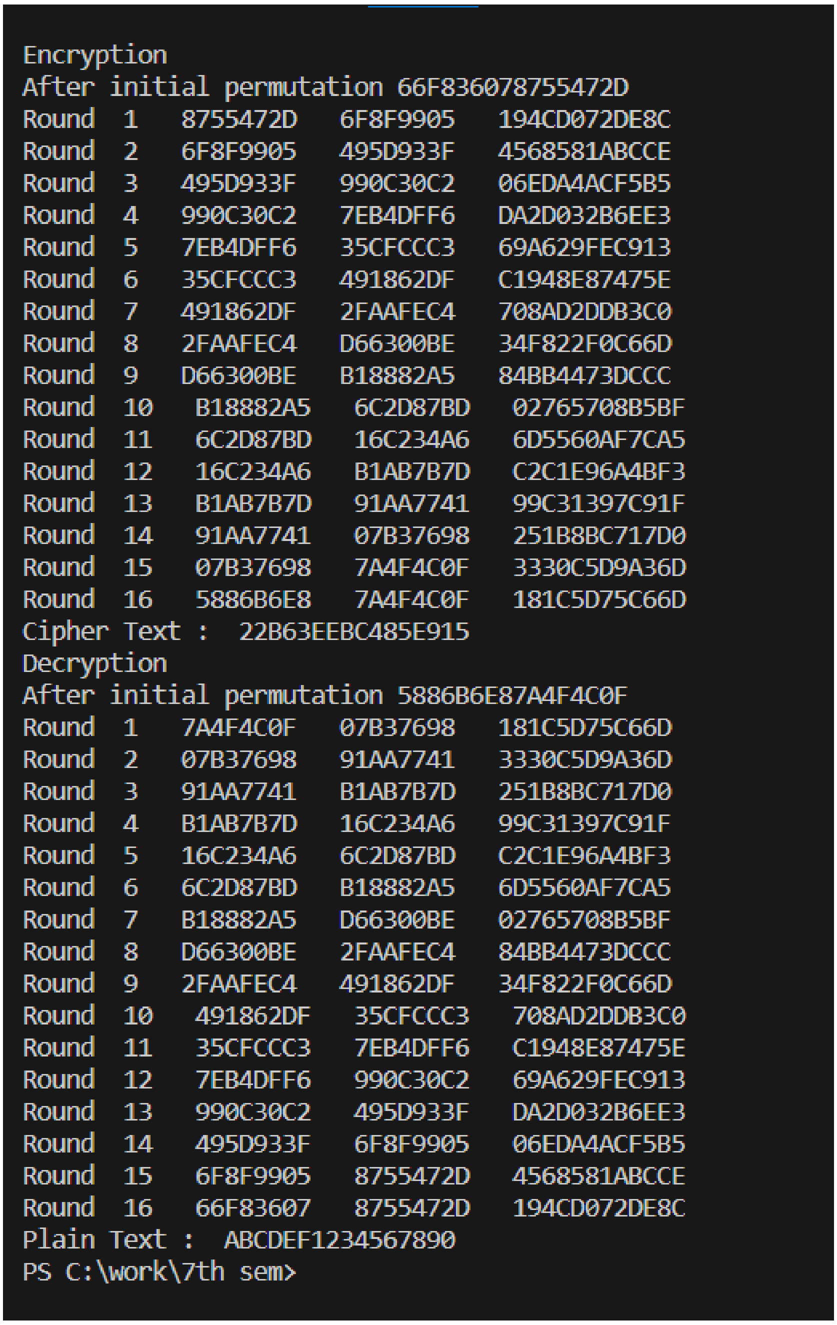
Code:

```
def hex2bin(s):
        mp = {'0': "0000",
                '1': "0001",
                '2': "0010",
                '3': "0011",
                '4': "0100",
                '5': "0101",
                '6': "0110",
                '7': "0111",
                '8': "1000",
                '9': "1001",
                'A': "1010",
                'B': "1011",
                'C': "1100",
                'D': "1101",
                'E': "1110",
                'F': "1111"}
        bin = ""
        for i in range(len(s)):
                bin = bin + mp[s[i]]
        return bin
def bin2hex(s):
        mp = {"0000": '0',
                "0001": '1',
                "0010": '2',
                "0011": '3',
                "0100": '4',
                "0101": '5',
                "0110": '6',
                "0111": '7',
                "1000": '8',
                "1001": '9',
                "1010": 'A',
                "1011": 'B',
                "1100": 'C',
                "1101": 'D',
                "1110": 'E',
                "1111": 'F'}
        hex = ""
        for i in range(0, len(s), 4):
                ch = ""
                ch = ch + s[i]
                ch = ch + s[i + 1]
                ch = ch + s[i + 2]
                ch = ch + s[i + 3]
                hex = hex + mp[ch]
        return hex
def bin2dec(binary):
        decimal, i = 0, 0
        while(binary != 0):
                dec = binary % 10
                decimal = decimal + dec * pow(2, i)
                binary = binary//10
                i += 1
        return decimal
```

```
def dec2bin(num):
        res = bin(num).replace("0b", "")
        if(len(res) % 4 != 0):
                div = len(res) / 4
                div = int(div)
                counter = (4 * (div + 1)) - len(res)
                for i in range(0, counter):
                        res = '0' + res
        return res
def permute(k, arr, n):
        permutation = ""
        for i in range(0, n):
                permutation = permutation + k[arr[i] - 1]
        return permutation
def shift_left(k, nth_shifts):
        s = ""
        for i in range(nth_shifts):
                for j in range(1, len(k)):
                        s = s + k[j]
                s = s + k[0]
                k = s
                s = ""
        return k
def xor(a, b):
        ans = ""
        for i in range(len(a)):
                if a[i] == b[i]:
                        ans = ans + "0"
                else:
                    ans = ans + "1"
        return ans
initial_perm = [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]
exp_d = [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]
per = [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]
sbox = [[[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]]]
final_perm = [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]
def encrypt(pt, rkb, rk):
        pt = hex2bin(pt)
        pt = permute(pt, initial_perm, 64)
        print("After initial permutation", bin2hex(pt))
        left = pt[0:32]
        right = pt[32:64]
        for i in range(0, 16):
                right_expanded = permute(right, exp_d, 48)
                xor_x = xor(right_expanded, rkb[i])
                sbox_str = ""
                for j in range(0, 8):
                    row = bin2dec(int(xor_x[j * 6] + xor_x[j * 6 + 5]))
                    col = bin2dec(
                        int(xor_x[j * 6 + 1] + xor_x[j * 6 + 2] + xor_x[j * 6 + 3] +
xor_x[j * 6 + 4]))
                    val = sbox[j][row][col]
                    sbox_str = sbox_str + dec2bin(val)
                sbox_str = permute(sbox_str, per, 32)
                result = xor(left, sbox_str)
                left = result
                if(i != 15):
                    left, right = right, left
                print("Round ", i + 1, " ", bin2hex(left),
                    " ", bin2hex(right), " ", rk[i])
        combine = left + right
        cipher_text = permute(combine, final_perm, 64)
        return cipher_text
pt = "ABCDEF1234567890"
key = "AABB09182736CCDD"
key = hex2bin(key)
keyp = [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]
key = permute(key, keyp, 56)
shift_table = [1, 1, 2, 2,2, 2, 2, 2,1, 2, 2, 2,2, 2, 2, 1]
key_comp = [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]
left = key[0:28]
right = key[28:56]
rkb = []
rk = []
```

```
for i in range(0, 16):
        left = shift_left(left, shift_table[i])
        right = shift_left(right, shift_table[i])
        combine_str = left + right
        round_key = permute(combine_str, key_comp, 48)
        rkb.append(round_key)
        rk.append(bin2hex(round_key))
print("Encryption")
cipher_text = bin2hex(encrypt(pt, rkb, rk))
print("Cipher Text : ", cipher_text)
print("Decryption")
rkb_rev = rkb[::-1]
rk_rev = rk[::-1]
text = bin2hex(encrypt(cipher_text, rkb_rev, rk_rev))
print("Plain Text : ", text)
```

output:



```
Encryption
After initial permutation 66F836078755472D
Round  1   8755472D   6F8F9905   194CD072DE8C
Round  2   6F8F9905   495D933F   4568581ABCCE
Round  3   495D933F   990C30C2   06EDA4ACF5B5
Round  4   990C30C2   7EB4DFF6   DA2D032B6EE3
Round  5   7EB4DFF6   35CFCCC3   69A629FEC913
Round  6   35CFCCC3   491862DF   C1948E87475E
Round  7   491862DF   2FAAFEC4   708AD2DDB3C0
Round  8   2FAAFEC4   D66300BE   34F822F0C66D
Round  9   D66300BE   B18882A5   84BB4473DCCC
Round  10   B18882A5   6C2D87BD   02765708B5BF
Round  11   6C2D87BD   16C234A6   6D5560AF7CA5
Round  12   16C234A6   B1AB7B7D   C2C1E96A4BF3
Round  13   B1AB7B7D   91AA7741   99C31397C91F
Round  14   91AA7741   07B37698   251B8BC717D0
Round  15   07B37698   7A4F4C0F   3330C5D9A36D
Round  16   5886B6E8   7A4F4C0F   181C5D75C66D
Cipher Text :  22B63EEBC485E915
Decryption
After initial permutation 5886B6E87A4F4C0F
Round  1   7A4F4C0F   07B37698   181C5D75C66D
Round  2   07B37698   91AA7741   3330C5D9A36D
Round  3   91AA7741   B1AB7B7D   251B8BC717D0
Round  4   B1AB7B7D   16C234A6   99C31397C91F
Round  5   16C234A6   6C2D87BD   C2C1E96A4BF3
Round  6   6C2D87BD   B18882A5   6D5560AF7CA5
Round  7   B18882A5   D66300BE   02765708B5BF
Round  8   D66300BE   2FAAFEC4   84BB4473DCCC
Round  9   2FAAFEC4   491862DF   34F822F0C66D
Round  10   491862DF   35CFCCC3   708AD2DDB3C0
Round  11   35CFCCC3   7EB4DFF6   C1948E87475E
Round  12   7EB4DFF6   990C30C2   69A629FEC913
Round  13   990C30C2   495D933F   DA2D032B6EE3
Round  14   495D933F   6F8F9905   06EDA4ACF5B5
Round  15   6F8F9905   8755472D   4568581ABCCE
Round  16   66F83607   8755472D   194CD072DE8C
Plain Text :  ABCDEF1234567890
PS C:\work\7th sem>
```

AIM: Implement AES algorithm.

Code:

```
from Crypto.Cipher import AES
from Crypto.Random import get_random_bytes
from Crypto.Protocol.KDF import PBKDF2
from Crypto.Util.Padding import pad, unpad

def generate_key(password):
    # Generate a 256-bit (32 bytes) key using PBKDF2 with 100,000 iterations
    salt = get_random_bytes(16)
    key = PBKDF2(password, salt, dkLen=32, count=100000)
    return key, salt

def aes_encrypt(key, plaintext):
    # Generate a random 16-byte IV (Initialization Vector)
    iv = get_random_bytes(16)
    cipher = AES.new(key, AES.MODE_CBC, iv)
    ciphertext = cipher.encrypt(pad(plaintext, AES.block_size))
    return ciphertext, iv

def aes_decrypt(key, ciphertext, iv):
    cipher = AES.new(key, AES.MODE_CBC, iv)
    plaintext = unpad(cipher.decrypt(ciphertext), AES.block_size)
    return plaintext

if __name__ == "__main__":
    # Ask the user to enter a password
    password = input("Enter The Password: ")
```

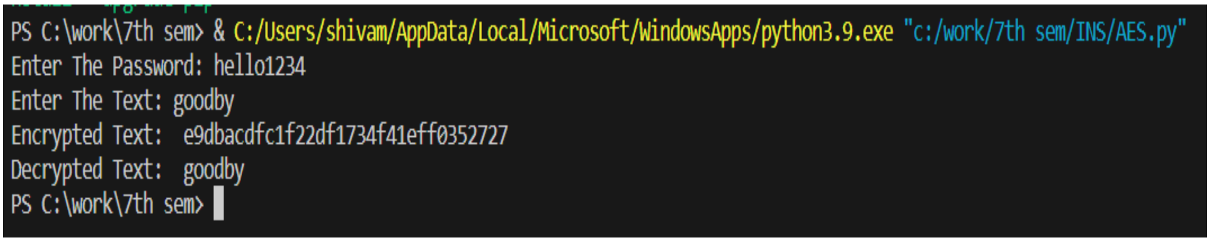
```
key, salt = generate_key(password.encode())

# Ask the user to enter the plaintext as a string
plaintext = input("Enter The Text: ").encode()

encrypted_text, iv = aes_encrypt(key, plaintext)
decrypted_text = aes_decrypt(key, encrypted_text, iv)

print("Encrypted Text: ", encrypted_text.hex())
print("Decrypted Text: ", decrypted_text.decode())
```

output:



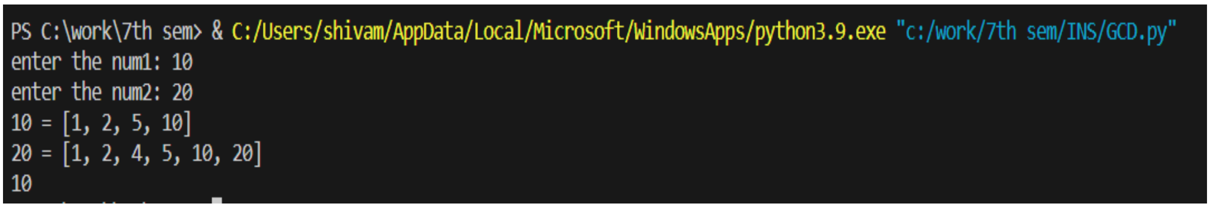
```
PS C:\work\7th sem> & C:/Users/shivam/AppData/Local/Microsoft/WindowsApps/python3.9.exe "c:/work/7th sem/INS/AES.py"
Enter The Password: hello1234
Enter The Text: goodby
Encrypted Text:  e9dbacdfc1f22df1734f41eff0352727
Decrypted Text:  goodby
PS C:\work\7th sem> 
```

AIM: Implement GCD.

Code:

```
num1 = int(input("enter the num1: "))
num2 = int(input("enter the num2: "))
l1 = []
l2 = []
for i in range(1,num1+1):
    if num1 % i == 0:
        l1.append(i)
for i in range(1,num2+1):
    if num2 % i == 0:
        l2.append(i)
print(num1 , "=" , l1)
print(num2 , "=" , l2)
for i in l1:
    for j in l2:
        if i == j:
            max_num = i
print(max_num)
```

Output:



```
PS C:\work\7th sem> & C:/Users/shivam/AppData/Local/Microsoft/WindowsApps/python3.9.exe "c:/work/7th sem/INS/GCD.py"
enter the num1: 10
enter the num2: 20
10 = [1, 2, 5, 10]
20 = [1, 2, 4, 5, 10, 20]
10
```