CRYPTOGRAPHY & NETWORK SECURITY

Lab Manual

JNTUK – R16

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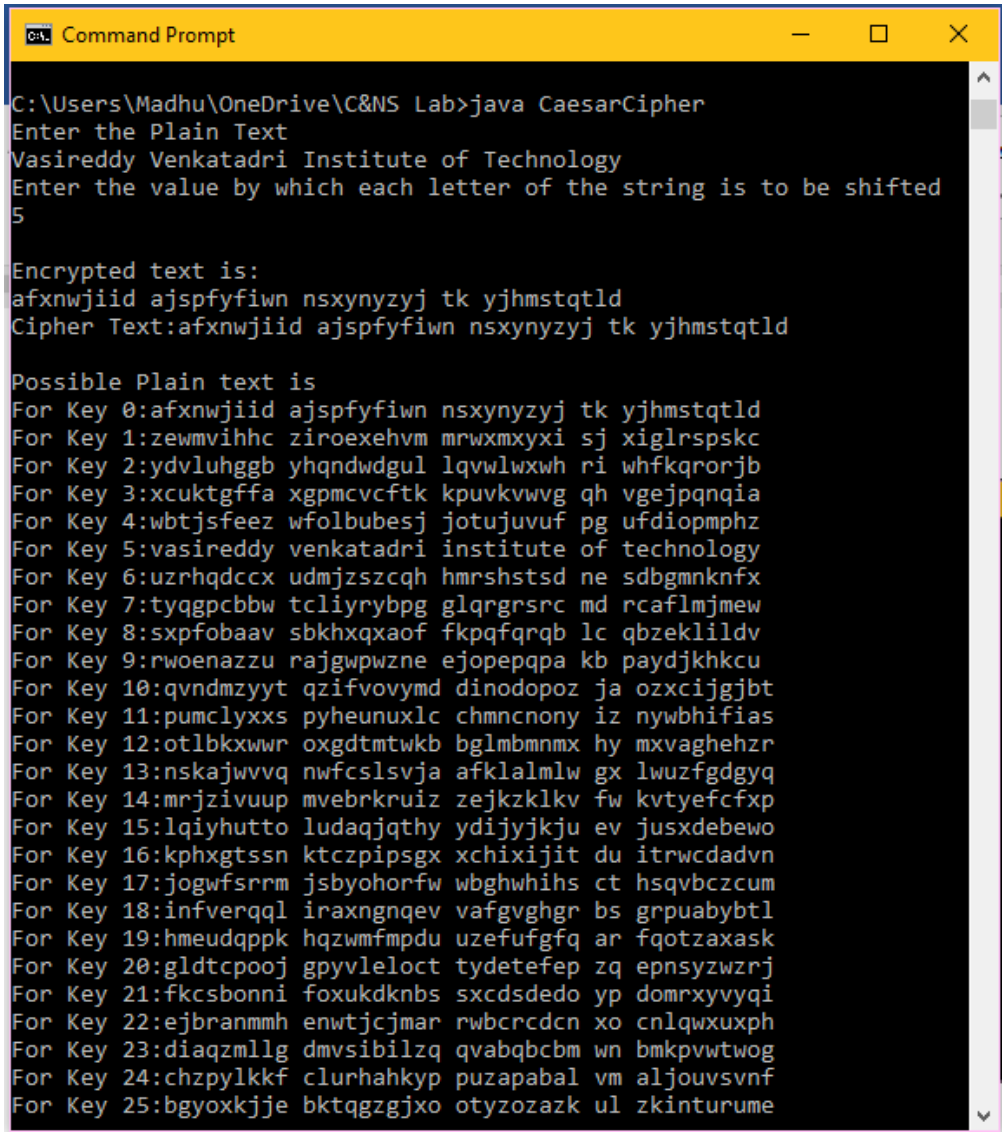
1. Aim: Program to break Shift Cipher

Program:

```
import java.util.*;
class CaesarCipher
{
	public static void main(String args[])
	{
		Scanner sc=new Scanner(System.in);
		int shift,i,n,p,key;
		String str;
		String str1="";
		System.out.println("Enter the Plain Text");
		str=sc.nextLine();
		str=str.toLowerCase();
		n=str.length();
		char ch1[]=str.toCharArray();
		char ch4;
		System.out.println("Enter the value by which each letter of the string is to be shifted");
		shift=sc.nextInt();
		System.out.println();
		System.out.println("Encrypted text is:");
		for(i=0;i<n;i++)
		{
			if(Character.isLetter(ch1[i]))
			{
				ch4=(char)(((int)ch1[i]+shift-97)%26+97);
				str1=str1+ch4;
			}
			else if(ch1[i]==' ')
			{
				str1=str1+ch1[i];
			}
		}
		System.out.println(str1);
		System.out.println("Cipher Text:"+str1);
		n=str1.length();
		char ch2[]=str1.toCharArray();
		char ch3;
		System.out.println();
		System.out.println("Possible Plain text is");
		str1="";
		for(key=26;key>=1;key--)
		{
			for(i=0;i<n;i++)
			{
				if(Character.isLetter(ch2[i]))
				{
```

```
                                ch3=(char)(((int)ch2[i]+key-97)%26+97);
                                str1=str1+ch3;
                        }
                        else if(ch2[i]==' ')
                        {
                                str1=str1+ch2[i];
                        }
                }
                p=26-key;
                System.out.println("For Key "+p+":"+str1);
                str1="";
        }
    }
}
```

Output:



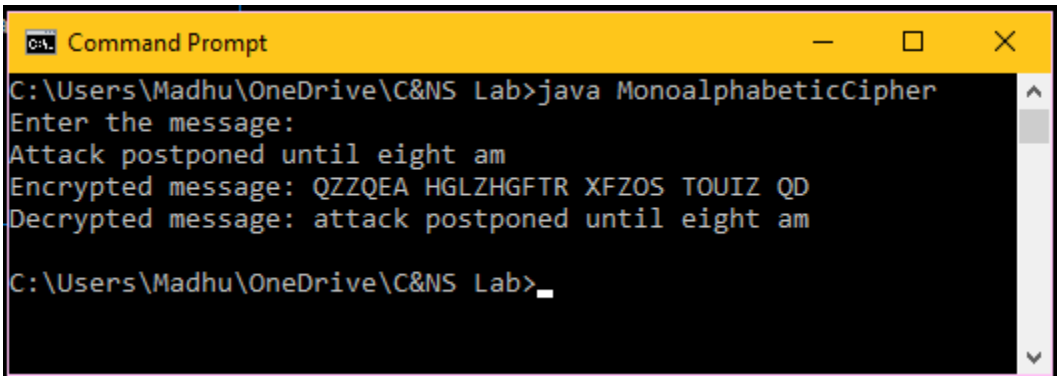
2. Aim: Program to break Mono-alphabetic cipher

Program:

```
import java.util.Scanner;
public class MonoalphabeticCipher
{
    public static char p[]  = { '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' };
    public static char ch[] = { 'Q', 'W', 'E', 'R', 'T', 'Y', 'U', 'I', 'O',
            'P', 'A', 'S', 'D', 'F', 'G', 'H', 'J', 'K', 'L', 'Z', 'X', 'C',
            'V', 'B', 'N', 'M' };
    static String str;
    public static String doEncryption(String s)
    {
        char c[] = new char[(s.length())];
        for (int i = 0; i < s.length(); i++)
        {
            for (int j = 0; j < 26; j++)
            {
                if (p[j] == s.charAt(i))
                {
                    c[i] = ch[j];
                    break;
                }
            }
        }
        return (new String(c));
    }

    public static String doDecryption(String s)
    {
        char p1[] = new char[(s.length())];
        for (int i = 0; i < s.length(); i++)
        {
            for (int j = 0; j < 26; j++)
            {
                if (ch[j] == s.charAt(i))
                {
                    p1[i] = p[j];
                    break;
                }
            }
        }
        return (new String(p1));
    }

    public static void main(String args[])
```

```
    {
        Scanner sc = new Scanner(System.in);
        System.out.println("Enter the message: ");
        str=sc.next();
        String en = doEncryption(str.toLowerCase());
        System.out.println("Encrypted message: " + en);
        System.out.println("Decrypted message: " + doDecryption(en));
        sc.close();
    }
}
```

Output:



3. Aim: Program to implement One-time pad

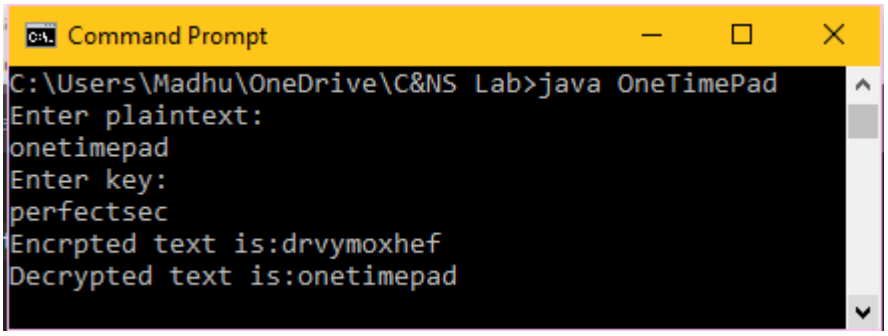
Program:

```
import java.util.*;
class msg{
	int a=97;
	char all[]=new char[27];
	msg()
	{
		for(int i=0;i<26;i++)
		{
			all[i]=(char)a;
			a++;
		}
	}
	int Ipos(char c)
	{
		int i=0;
		for(;i<26;i++)
		{
			if(all[i]==c)
			{
				break;
			}
		}
		return i;
	}
	char Cpos(int c)
	{
		int i=0;
		for(;i<c;i++)
		{
		}
		return all[i];
	}
}
class OneTimePadCipherImplementation{
String Encryption(String plaintext,String key)
{
	plaintext=plaintext.toLowerCase();
	msg m1=new msg();
	int pt[]=new int[plaintext.length()];
	int k[]=new int[key.length()];
	int ct[]=new int[plaintext.length()];
	for(int i=0;i < plaintext.length();i++)
	{
		pt[i]=m1.Ipos(plaintext.charAt(i));
	}
```

```
        for(int i=0;i < key.length();i++)
        {
                k[i]=m1.Ipos(key.charAt(i));
        }
        int j=0;
        for(int i=0;i < plaintext.length();i++)
        {
                ct[i]=pt[i]+k[j];
                j++;
                if(j==key.length())
                j=0;
                if(ct[i]>26)
                ct[i]=ct[i]%26;
        }
        String cipher="";
        for(int i=0;i < plaintext.length();i++)
        {
                cipher+=m1.Cpos(ct[i]);
        }
        return cipher;
}
String Decryption(String ciphertext,String key)
{
        String plaintext="";
        msg m1=new msg();
        int pt[]=new int[ciphertext.length()];
        int k[]=new int[key.length()];
        int ct[]=new int[ciphertext.length()];
        for(int i=0;i < ciphertext.length();i++)
        {
                ct[i]=m1.Ipos(ciphertext.charAt(i));
        }
        for(int i=0;i < key.length();i++)
        {
                k[i]=m1.Ipos(key.charAt(i));
        }
        int j=0;
        for(int i=0;i < ciphertext.length();i++)
        {
                pt[i]=ct[i]-k[j];
                j++;
                if(j==key.length())
                j=0;
                if(pt[i] < 0)
                pt[i]+=26;
        }
        String cipher="";
        for(int i=0;i < ciphertext.length();i++)
        {
                plaintext+=m1.Cpos(pt[i]);
```

```
        }
        return plaintext;
}
}

class OneTimePad{
        public static void main(String args[])throws Exception
        {
                String plaintext,key;
                Scanner scn=new Scanner(System.in);
                System.out.println("Enter plaintext:");
                plaintext=scn.nextLine();
                System.out.println("Enter key:");
                key=scn.nextLine();
                OneTimePadCipherImplementation OneTimePad=new
OneTimePadCipherImplementation();
                String ciphertext=OneTimePad.Encryption(plaintext,key);
                System.out.println("Encrpted text is:"+ciphertext);
                System.out.println("Decrypted text is:"+OneTimePad.Decryption(ciphertext,key));
        }
}
```

Output:

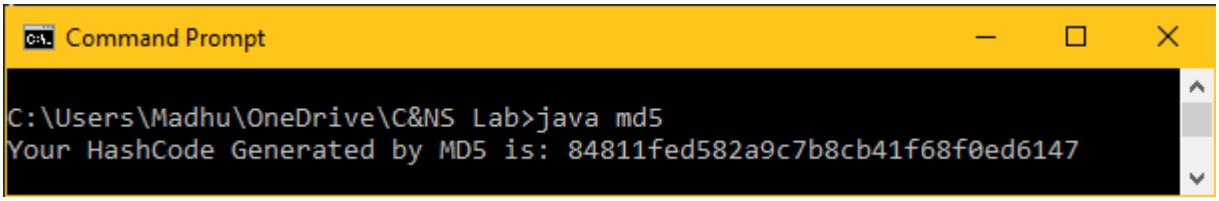


4. Aim: Program to implement Message authentication codes (MD5)

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 = "VVIT";
		System.out.println("Your HashCode Generated by MD5 is: " + getMd5(s));
	}
}
```

Output:


Command Prompt
C:\Users\Madhu\OneDrive\C&NS Lab>java md5
Your HashCode Generated by MD5 is: 84811fed582a9c7b8cb41f68f0ed6147

5. Aim: Program to implement Cryptographic Hash Function (SHA-256)

Program:

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

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

			// Static getInstance method is called with hashing MD5
			MessageDigest hash = MessageDigest.getInstance("SHA-256");

			// digest() method is called to calculate message digest
			// of an input digest() return array of byte
			byte[] messageDigest = hash.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 = "VVIT";
		System.out.println("Your HashCode Generated by SHA is: " + getSHA(s));
	}
}
```

Output:


Command Prompt
C:\Users\Madhu\OneDrive\C&NS Lab>java SHA
Your HashCode Generated by SHA is: 4648713776340a1d8933bd6079d6440d120204deb21bde2ae2535022ff19607f

6. Aim: Program to implement DES Symmetric Encryption

Program:

```
import javax.crypto.Cipher;
import javax.crypto.KeyGenerator;
import javax.crypto.SecretKey;
import java.util.Base64;

class DesEncrypter {
  Cipher ecipher;
  Cipher dcipher;

  DesEncrypter(SecretKey key) throws Exception {
    ecipher = Cipher.getInstance("DES");
    dcipher = Cipher.getInstance("DES");
    ecipher.init(Cipher.ENCRYPT_MODE, key);
    dcipher.init(Cipher.DECRYPT_MODE, key);
  }

  public String encrypt(String str) throws Exception {
    // Encode the string into bytes using utf-8
    byte[] utf8 = str.getBytes("UTF8");

    // Encrypt
    byte[] enc = ecipher.doFinal(utf8);

    // Encode bytes to base64 to get a string
    //return new sun.misc.BASE64Encoder().encode(enc);
    return Base64.getEncoder().encodeToString(enc);
  }

  public String decrypt(String str) throws Exception {
    // Decode base64 to get bytes
    //byte[] dec = new sun.misc.BASE64Decoder().decodeBuffer(str);
    byte[] dec = Base64.getDecoder().decode(str);
    byte[] utf8 = dcipher.doFinal(dec);

    // Decode using utf-8
    return new String(utf8, "UTF8");
  }
}

public class DES {
  public static void main(String[] argv) throws Exception {
    SecretKey key = KeyGenerator.getInstance("DES").generateKey();
    DesEncrypter encrypter = new DesEncrypter(key);
    String encrypted = encrypter.encrypt("Don't tell anybody!");
    System.out.println(encrypted);
```

```
    String decrypted = encrypter.decrypt(encrypted);
    System.out.println(decrypted);
  }
}
```

Output:

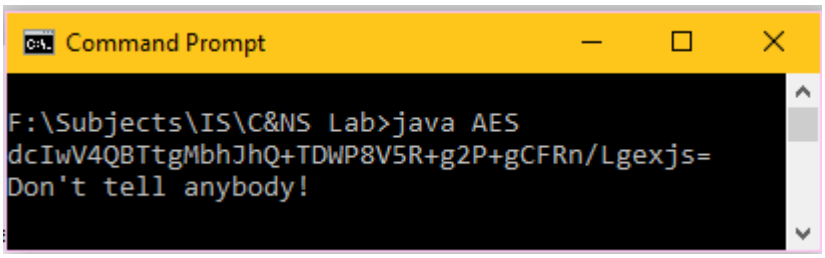
7. Aim: Program to implement AES Symmetric Encryption

Program:

```
import javax.crypto.Cipher;
import javax.crypto.KeyGenerator;
import javax.crypto.SecretKey;
import java.util.Base64;

class AesEncrypter {
  Cipher ecipher;

  Cipher dcipher;

  AesEncrypter(SecretKey key) throws Exception {
    ecipher = Cipher.getInstance("AES");
    dcipher = Cipher.getInstance("AES");
    ecipher.init(Cipher.ENCRYPT_MODE, key);
    dcipher.init(Cipher.DECRYPT_MODE, key);
  }

  public String encrypt(String str) throws Exception {
    // Encode the string into bytes using utf-8
    byte[] utf8 = str.getBytes("UTF8");

    // Encrypt
    byte[] enc = ecipher.doFinal(utf8);

    // Encode bytes to base64 to get a string
    //return new sun.misc.BASE64Encoder().encode(enc);
    return Base64.getEncoder().encodeToString(enc);
  }

  public String decrypt(String str) throws Exception {
    // Decode base64 to get bytes
    //byte[] dec = new sun.misc.BASE64Decoder().decodeBuffer(str);
    byte[] dec = Base64.getDecoder().decode(str);

    byte[] utf8 = dcipher.doFinal(dec);

    // Decode using utf-8
    return new String(utf8, "UTF8");
  }
}

public class AES {
  public static void main(String[] argv) throws Exception {
    SecretKey key = KeyGenerator.getInstance("AES").generateKey();
    AesEncrypter encrypter = new AesEncrypter(key);
```

```
    String encrypted = encrypter.encrypt("Don't tell anybody!");
    System.out.println(encrypted);
    String decrypted = encrypter.decrypt(encrypted);
    System.out.println(decrypted);
  }
}
```

Output:



8. Aim: Program to implement Diffie – Hellman Key Establishment

Program:

DHServer.java

```
import java.net.*;
import java.io.*;

public class DHServer {
	public static void main(String[] args) throws IOException
	{
		try {
			int port = 8088;
			// Server Key
			int b = 3;
			// Client p, g, and key
			double clientP, clientG, clientA, B, Bdash;
			String Bstr;

			// Established the Connection
			ServerSocket serverSocket = new ServerSocket(port);
			System.out.println("Waiting for client on port " + serverSocket.getLocalPort() +
"...");
			Socket server = serverSocket.accept();
			System.out.println("Just connected to " + server.getRemoteSocketAddress());

			// Server's Private Key
			System.out.println("From Server : Private Key = " + b);

			// Accepts the data from client
			DataInputStream in = new DataInputStream(server.getInputStream());

			clientP = Integer.parseInt(in.readUTF()); // to accept p
			System.out.println("From Client : P = " + clientP);

			clientG = Integer.parseInt(in.readUTF()); // to accept g
			System.out.println("From Client : G = " + clientG);

			clientA = Double.parseDouble(in.readUTF()); // to accept A
			System.out.println("From Client : Public Key = " + clientA);

			B = ((Math.pow(clientG, b)) % clientP); // calculation of B
			Bstr = Double.toString(B);

			// Sends data to client
			// Value of B
			OutputStream outToclient = server.getOutputStream();
			DataOutputStream out = new DataOutputStream(outToclient);
```

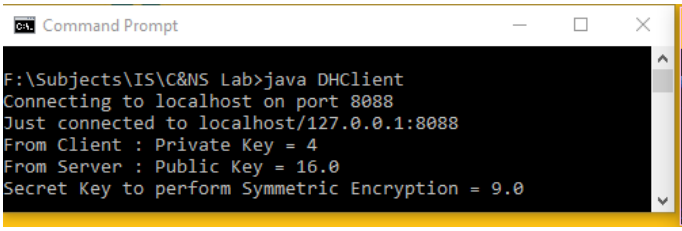
```
                        out.writeUTF(Bstr); // Sending B
                        Bdash = ((Math.pow(clientA, b)) % clientP); // calculation of Bdash
                        System.out.println("Secret Key to perform Symmetric Encryption = "
                                                        + Bdash);
                        server.close();
                }
                catch (SocketTimeoutException s) {
                        System.out.println("Socket timed out!");
                }
                catch (IOException e) {
                }
        }
}
```

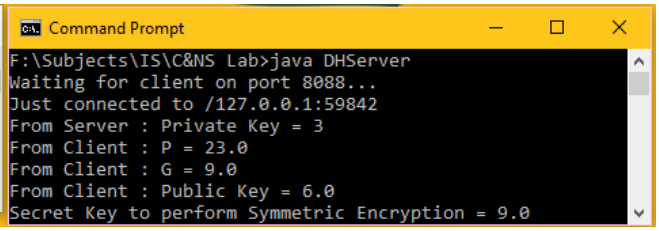
DHClient.java

```
import java.net.*;
import java.io.*;

public class DHClient {
        public static void main(String[] args)
        {
                try {
                        String pstr, gstr, Astr;
                        String serverName = "localhost";
                        int port = 8088;

                        // Declare p, g, and Key of client
                        int p = 23;
                        int g = 9;
                        int a = 4;
                        double Adash, serverB;

                        // Established the connection
                        System.out.println("Connecting to " + serverName
                                                        + " on port " + port);
                        Socket client = new Socket(serverName, port);
                        System.out.println("Just connected to "
                                                        + client.getRemoteSocketAddress());

                        // Sends the data to client
                        OutputStream outToServer = client.getOutputStream();
                        DataOutputStream out = new DataOutputStream(outToServer);

                        pstr = Integer.toString(p);
                        out.writeUTF(pstr); // Sending p

                        gstr = Integer.toString(g);
                        out.writeUTF(gstr); // Sending g
```

```
                    double A = ((Math.pow(g, a)) % p); // calculation of A
                    Astr = Double.toString(A);
                    out.writeUTF(Astr); // Sending A

                    // Client's Private Key
                    System.out.println("From Client : Private Key = " + a);

                    // Accepts the data
                    DataInputStream in = new DataInputStream(client.getInputStream());

                    serverB = Double.parseDouble(in.readUTF());
                    System.out.println("From Server : Public Key = " + serverB);

                    Adash = ((Math.pow(serverB, a)) % p); // calculation of Adash

                    System.out.println("Secret Key to perform Symmetric Encryption = "
                                                    + Adash);
                    client.close();
                }
                catch (Exception e) {
                    e.printStackTrace();
                }
        }
}
```

Output:





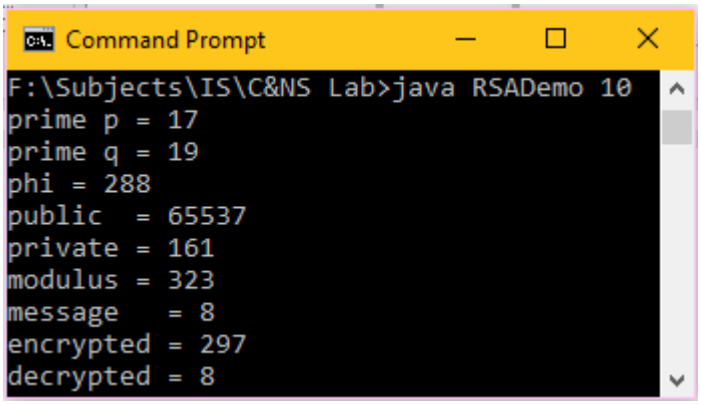
9. Aim: Program to implement Public Key Cryptosystems (RSA)

Program:

```
import java.math.BigInteger;
import java.security.SecureRandom;

public class RSADemo {
   private final static BigInteger one      = new BigInteger("1");
   private final static SecureRandom random = new SecureRandom();

   private BigInteger privateKey;
   private BigInteger publicKey;
   private BigInteger modulus;

   // generate an N-bit (roughly) public and private key
   RSADemo(int N) {
      BigInteger p = BigInteger.probablePrime(N/2, random);
      BigInteger q = BigInteger.probablePrime(N/2, random);
      BigInteger phi = (p.subtract(one)).multiply(q.subtract(one));
      System.out.println("prime p = " + p);
      System.out.println("prime q = " + q);

      modulus    = p.multiply(q);
      System.out.println("phi = " + phi);
      publicKey  = new BigInteger("65537");     // common value in practice = 2^16 + 1
      privateKey = publicKey.modInverse(phi);
   }

   BigInteger encrypt(BigInteger message) {
      return message.modPow(publicKey, modulus);
   }

   BigInteger decrypt(BigInteger encrypted) {
      return encrypted.modPow(privateKey, modulus);
   }

   public String toString() {
      String s = "";
      s += "public  = " + publicKey  + "\n";
      s += "private = " + privateKey + "\n";
      s += "modulus = " + modulus;
      return s;
   }

   public static void main(String[] args) {
      int N = Integer.parseInt(args[0]);
      RSADemo key = new RSADemo(N);
      System.out.println(key);
```

```
        // create random message, encrypt and decrypt
        BigInteger message = new BigInteger("8");

        //// create message by converting string to integer
        // String s = "test";
        // byte[] bytes = s.getBytes();
        // BigInteger message = new BigInteger(bytes);

        BigInteger encrypt = key.encrypt(message);
        BigInteger decrypt = key.decrypt(encrypt);
        System.out.println("message   = " + message);
        System.out.println("encrypted = " + encrypt);
        System.out.println("decrypted = " + decrypt);
    }
}
```

Output:



10. Aim: Program to Implement Digital Signatures (DSS)

Program:

```
import java.security.KeyPair;
import java.security.KeyPairGenerator;
import java.security.PrivateKey;
import java.security.PublicKey;
import java.security.Signature;
import java.util.Scanner;
import java.io.*;

public class CreatingDigitalSignature {
   public static void main(String args[]) throws Exception {
      //Accepting text from user
      Scanner sc = new Scanner(System.in);
      System.out.println("Enter some text");
      String msg = sc.nextLine();

      //Creating KeyPair generator object
      KeyPairGenerator keyPairGen = KeyPairGenerator.getInstance("DSA");

      //Initializing the key pair generator
      keyPairGen.initialize(2048);

      //Generate the pair of keys
      KeyPair pair = keyPairGen.generateKeyPair();

      //Getting the private key from the key pair
      PrivateKey privKey = pair.getPrivate();
      PublicKey pubKey = pair.getPublic();
      System.out.println(privKey);
      System.out.println(pubKey);

      //Creating a Signature object
      Signature sign = Signature.getInstance("SHA256withDSA");

      //Initialize the signature
      sign.initSign(privKey);
      byte[] bytes = "msg".getBytes();

      //Adding data to the signature
      sign.update(bytes);

      //Calculating the signature
      byte[] signature = sign.sign();

      //Printing Signature to console
      for(int i=0;i<signature.length;i++)
```

```
            System.out.print(" "+signature[i]);
        System.out.println();

        //Initializing the signature verification
        sign.initVerify(pair.getPublic());
        sign.update(bytes);

        //Verifying the signature
        boolean bool = sign.verify(signature);

        if(bool) {
            System.out.println("Signature verified");
        } else {
        System.out.println("Signature failed");
    }
  }
}
```

Output: