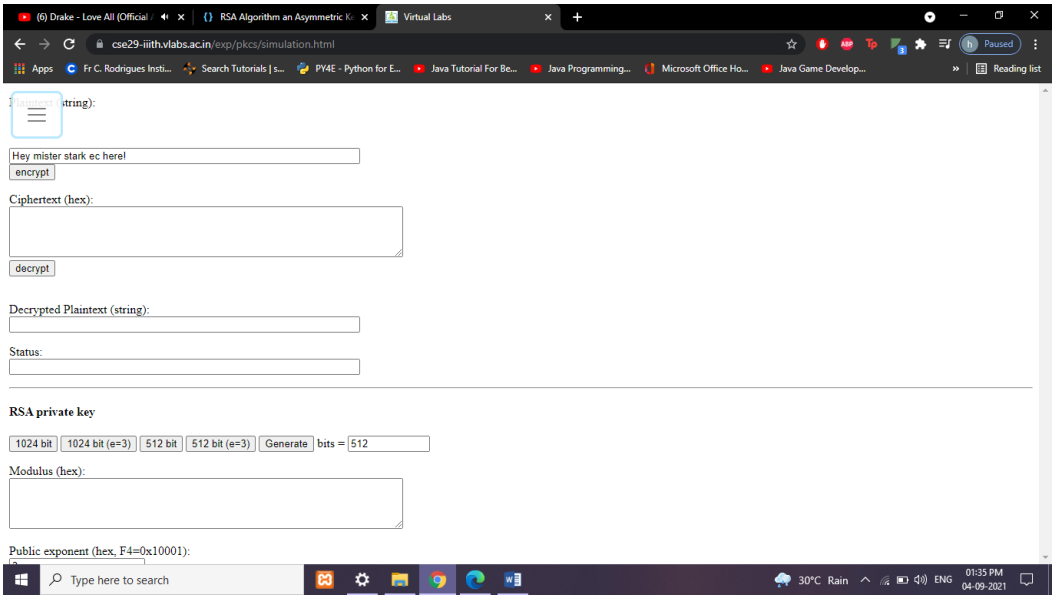
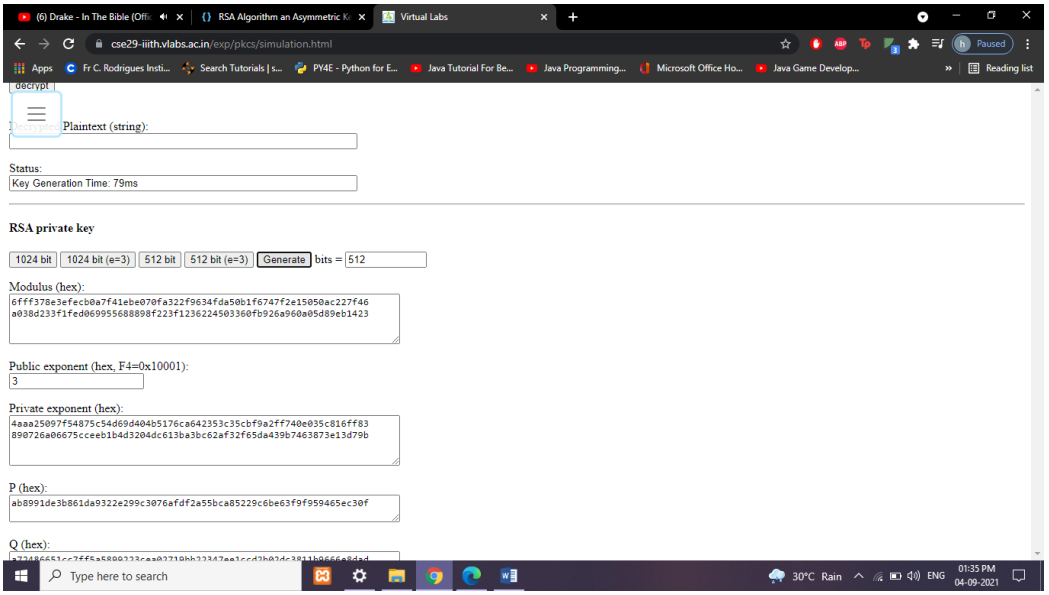
Tool used :
https://cse29-iiith.vlabs.ac.in/exp

RSA CRYPTOSYSTEM

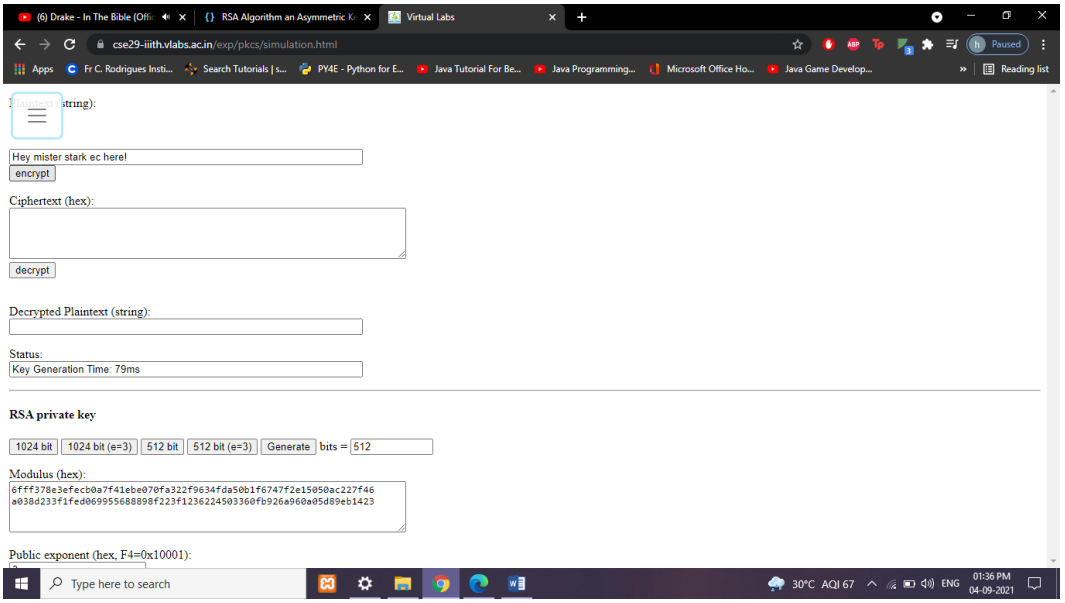
Step 1 : Enter the input text to be encrypted in the 'Plaintext' area

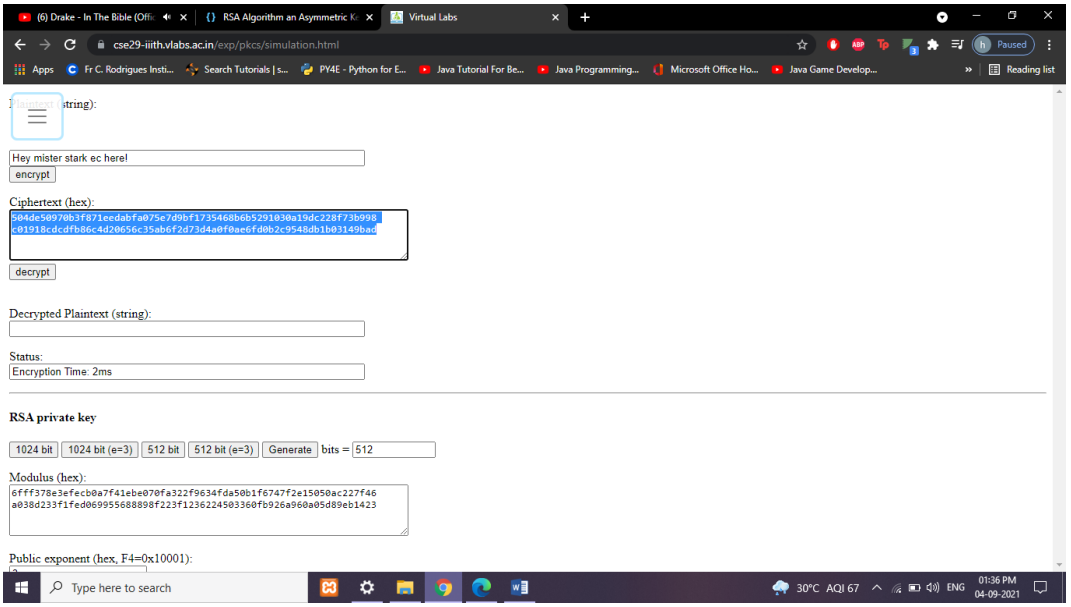


Step 2 : Select key size of public key from **RSA Private key** section by clicking on one of the key button.

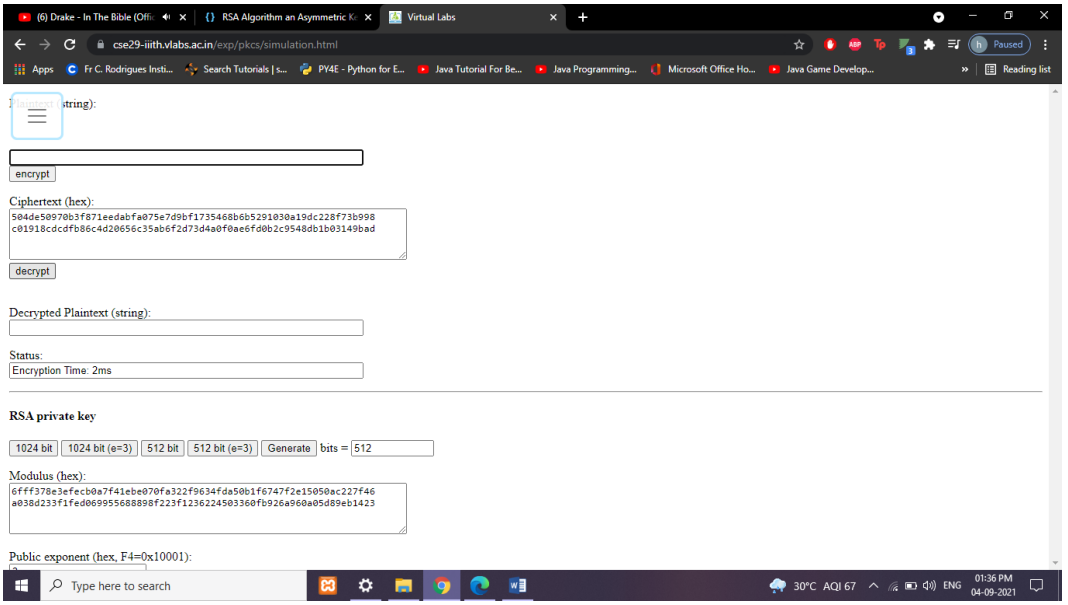


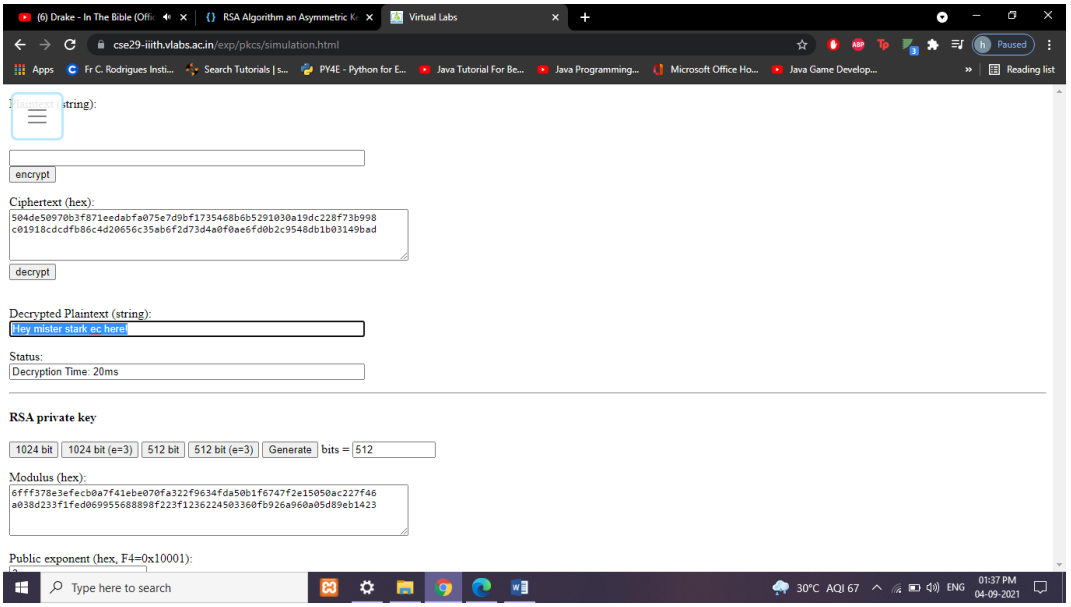
Step 3 : Click on **encrypt** button to generate a ciphertext.





Conversely we can decrypt with the same steps , i.e. put the same ciphertext in the cipher box then the generated key for the encryption is used to decrypt the cipher.





CODE:

```
import math

print("RSA ENCRYPTOR/DECRYPTOR")

print(" ")

#Input Prime Numbers

print("PLEASE ENTER THE 'p' AND 'q' VALUES BELOW:")

p = int(input("Enter a prime number for p: "))

q = int(input("Enter a prime number for q: "))

print(" ")
```

```
#Check if Input's are Prime
def prime_check(a):
    if(a==2):
        return True
    elif((a<2) or ((a%2)==0)):
        return False
    elif(a>2):
        for i in range(2,a):
            if not(a%i):
                return False
    return True
check_p = prime_check(p)
check_q = prime_check(q)
while(((check_p==False)or(check_q==False))):
    p = int(input("Enter a prime number for p: "))
    q = int(input("Enter a prime number for q: "))
    check_p = prime_check(p)
    check_q = prime_check(q)
#RSA Modulus
n = p * q
print("RSA Modulus(n) is:",n)
#Eulers Toitent
r= (p-1)*(q-1)
print("Eulers Toitent(r) is:",r)
print(" ")

#GCD for 'e' cal
def egcd(e,r):
    while(r!=0):
        e,r=r,e%r
    return e
#Euclid's Algorithm
```

```
def eugcd(e,r):
    for i in range(1,r):
        while(e!=0):
            a,b=r//e,r%e
            if(b!=0):
                print("%d = %d*(%d) + %d"%(r,a,e,b))
            r=e
            e=b
#Extended Euclidean Algorithm
def eea(a,b):
    if(a%b==0):
        return(b,0,1)
    else:
        gcd,s,t = eea(b,a%b)
        s = s-((a//b) * t)
        print("%d = %d*(%d) + (%d)*(%d)"%(gcd,a,t,s,b))
        return(gcd,t,s)

#Multiplicative Inverse
def mult_inv(e,r):
    gcd,s,_=eea(e,r)
    if(gcd!=1):
        return None
    else:
        if(s<0):
            print("s=%d. Since %d is less than 0, s = s(modr), i.e.,
s=%d."%(s,s,s%r))
        elif(s>0):
            print("s=%d."%(s))
        return s%r
#e Value Calculation
'''FINDS THE HIGHEST POSSIBLE VALUE OF 'e' BETWEEN 1 and 1000 THAT
MAKES (e,r) COPRIME.'''
```

```
for i in range(1,1000):
    if(egcd(i,r)==1):
        e=i
print("The value of e is:",e)
print(" ")
#d, Private and Public Keys
'''CALCULATION OF 'd', PRIVATE KEY, AND PUBLIC KEY.'''
print("EUCLID'S ALGORITHM:")
eugcd(e,r)
print("END OF THE STEPS USED TO ACHIEVE EUCLID'S ALGORITHM.")
print(" ")
print("EUCLID'S EXTENDED ALGORITHM:")
d = mult_inv(e,r)
print("END OF THE STEPS USED TO ACHIEVE THE VALUE OF 'd'.")
print("The value of d is:",d)
print(" ")
public = (e,n)
private = (d,n)
print("Private Key is:",private)
print("Public Key is:",public)
print(" ")
#Encryption
'''ENCRYPTION ALGORITHM.'''
def encrypt(pub_key,n_text):
    e,n=pub_key
    x=[]
    m=0
    for i in n_text:
        if(i.isupper()):
            m = ord(i)-65
            c=(m**e)%n
            x.append(c)
```

```
        elif(i.islower()):
            m= ord(i)-97
            c=(m**e)%n
            x.append(c)
        elif(i.isspace()):
            spc=400
            x.append(400)
    return x


#Decryption
'''DECRYPTION ALGORITHM'''
def decrypt(priv_key,c_text):
    d,n=priv_key
    txt=c_text.split(',')
    x=''
    m=0
    for i in txt:
        if(i=='400'):
            x+=' '
        else:
            m=(int(i)**d)%n
            m+=65
            c=chr(m)
            x+=c
    return x
# #Message
message = input("What would you like encrypted or decrypted?(Separate
numbers with ',' for decryption):")
print("Your message is:",message)
#Choose Encrypt or Decrypt and Print
choose = input("Type '1' for encryption and '2' for decrytion.")
```

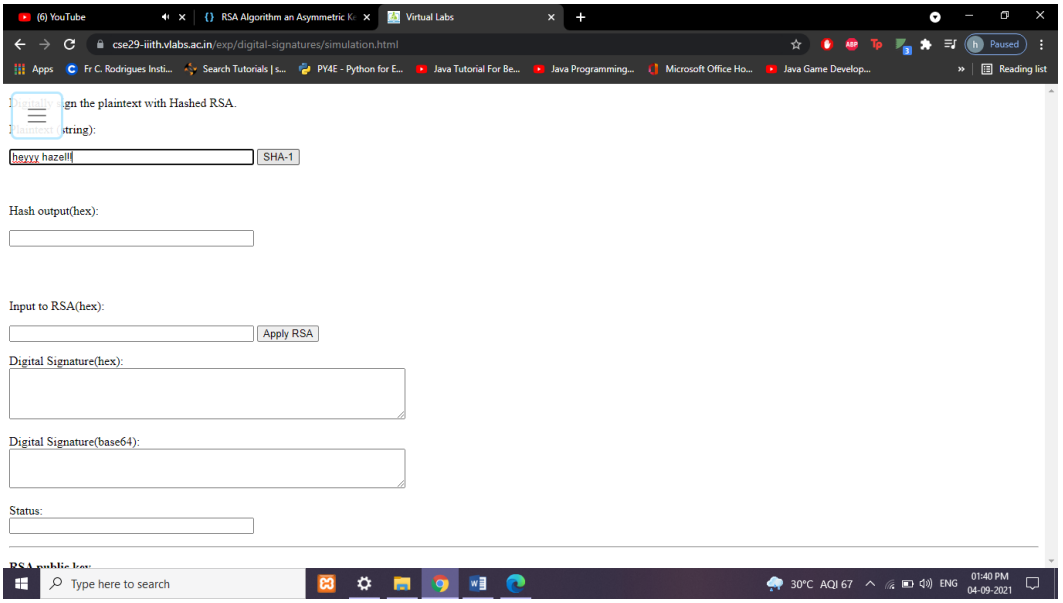
```
if(choose=='1'):
    enc_msg=encrypt(public,message)
    print("Your encrypted message is:",enc_msg)
elif(choose=='2'):
    print("Your decrypted message is:",decrypt(private,message))
else:
    print("You entered the wrong option.")
```

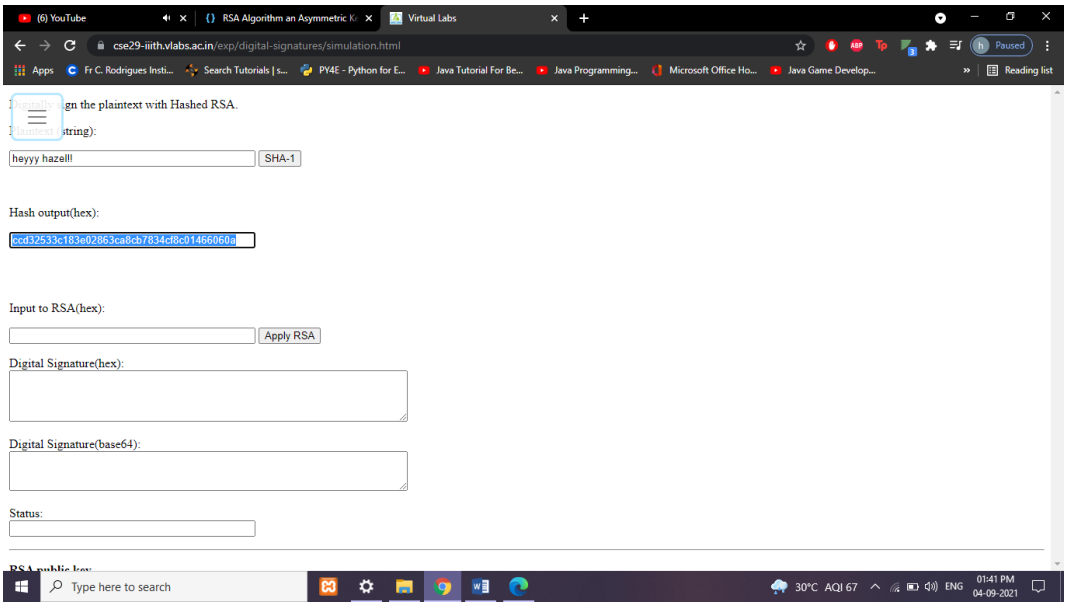
Output :

```
RSA ENCRYPTOR/DECRYPTOR

PLEASE ENTER THE 'p' AND 'q' VALUES BELOW:
Enter a prime number for p: 7
Enter a prime number for q: 13

RSA Modulus(n) is: 91
Eulers Toitent(r) is: 72

The value of e is: 997

EUCLID'S ALGORITHM:
72 = 0*(997) + 72
997 = 13*(72) + 61
72 = 1*(61) + 11
61 = 5*(11) + 6
11 = 1*(6) + 5
6 = 1*(5) + 1
END OF THE STEPS USED TO ACHIEVE EUCLID'S ALGORITHM.

EUCLID'S EXTENDED ALGORITHM:
1 = 6*(1) + (-1)*(5)
1 = 11*(-1) + (2)*(6)
1 = 61*(2) + (-11)*(11)
1 = 72*(-11) + (13)*(61)
1 = 997*(13) + (-180)*(72)
s=13.
END OF THE STEPS USED TO ACHIEVE THE VALUE OF 'd'.
The value of d is: 13

Private Key is: (13, 91)
Public Key is: (997, 91)

What would you like encrypted or decrypted?(Separate numbers with ',' for decryption):yes
Your message is: yes
Type '1' for encryption and '2' for decrytion.1
Your encrypted message is: [24, 4, 18]
```

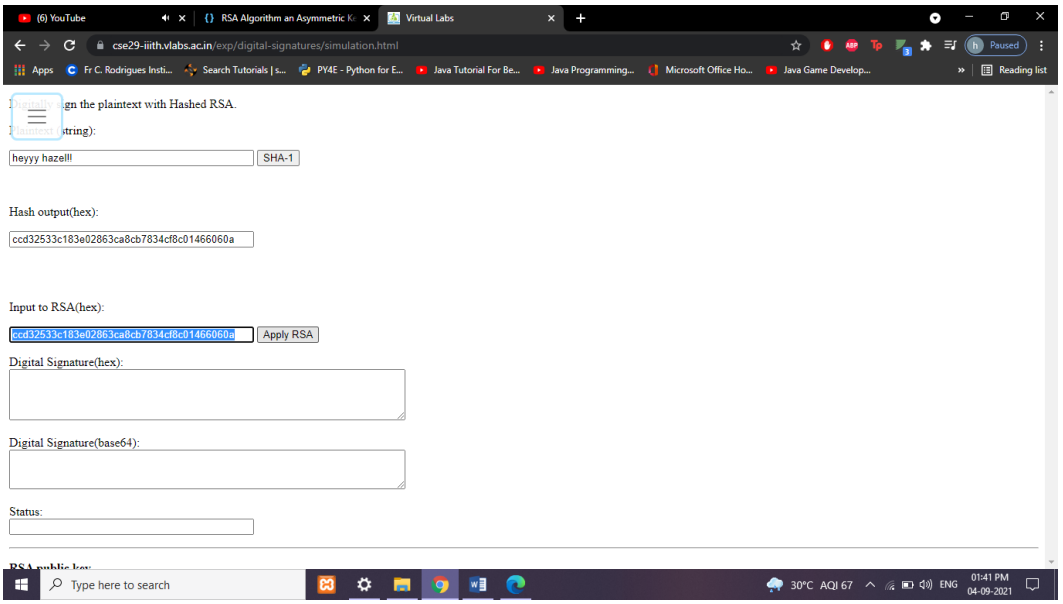
Digital Signatures Scheme

Step 1 : Enter the input text to be encrypted in the 'Plaintext' area and generate hash value for message by clicking on the **SHA-1** button

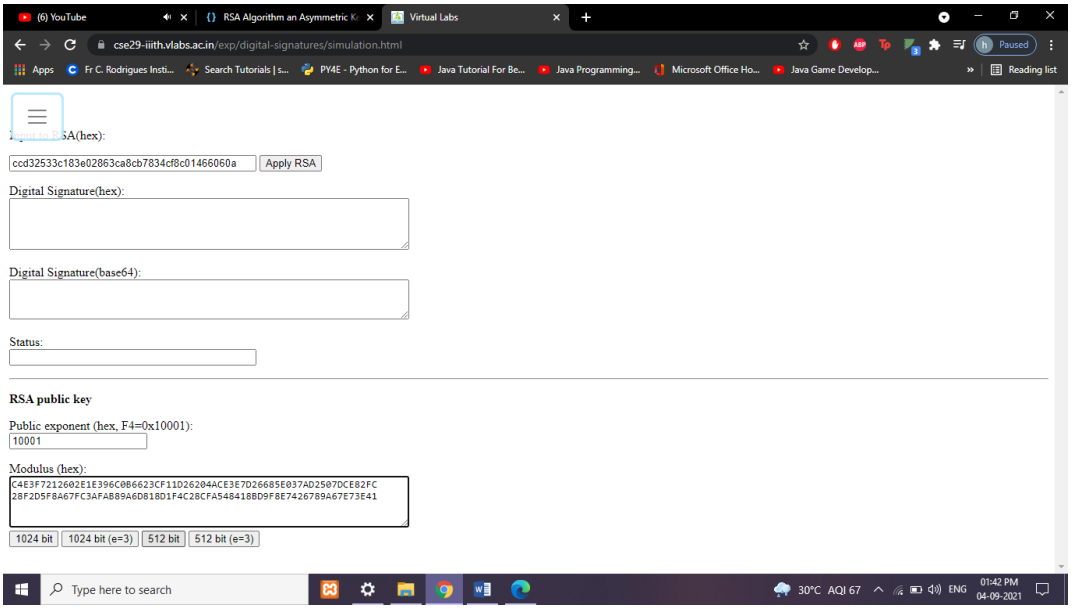




Step 2 : Copy content of Hash **Output(hex)** field and paste it in **Input to RSA(hex)** field.



Step 3 : Select key size of public key from **RSA Public key** section by clicking on any key button.



Step 4 : Click on **Apply RSA** button to generate a digital signature.