Mahavir Education Trust's

SHAH & ANCHOR KUTCHHI ENGINEERING COLLEGE

Chembur, Mumbai - 400 088

UG Program in Information Technology

Experiment No: 3				
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Program Formation/ Execution/ Correction (06)	**Timely Submission (01)**	**Viva (03)**	**Experiment Marks (10)**	**Teacher Signature with date**

EXPERIMENT - 03

AIM : Cryptographic Hash Functions & Applications (HMAC)

Cryptographic Hash Functions and Applications(HMAC)

1. Plaintext and Key Details:

- **Plaintext:** 1100000000111100101010
- **IV (Initialization Vector):** 11001100 (length = 8 bits)
- **Key (k):** 10000101 (length = 8 bits)
- **ipad:** 0x5C (01011100)
- **opad:** 0x36 (00110110)

2. Dividing the Plaintext into Chunks:

- Plaintext: 1100000000111100101010
- Let's break it into chunks of 8 bits each:
    - m1 = 11000000
    - m2 = 00111100
    - m3 = 101010 (6 bits, pad with two zeros to make 8 bits: 10101000)

3. Compute z0:

- Compute z0 = IV || (k XOR ipad)

  First, compute k XOR ipad

  k XOR ipad = 11011001

  IV || (k XOR ipad) = 11001100 || 11011001

  z0 = 1100110011011001

4. Compute z1:

- Compute z1 = z0 || m1:

  z1 = 1100110011011001 || 11000000

  z1 = 1100110011011001100111000000

5. Compute z2:

- Compute z2 = z1 || m2:

  z2 = 1100110011011001100111000000 || 00111100

  z2 = 1100110011011001100111000000000111100

6. Compute z3:

- Compute z3 = z2 || m3:

  z3 = 1100110011011001100111000000000111100 || 10101000

  z3 = 1100110011011001100111000000000111100101010000

7. Compute z4:

- Compute z4 = z3 || L where L is the length of m in bits (22 bits in total).

  L = 00010110

- Compute z4 = z3 || L:

  z4 = 1100110011011001100111000000000111100101010000000010110

8. Compute p:

- Compute p = IV || (k XOR opad)

  First, compute k XOR opad:
  k XOR opad = 10110011

- Concatenate IV with the result:
  css
  Copy code
  p = 11001100 || 10110011

p = 1100110010110011

9. Compute r:

Compute r = p || z4:

r = 1100110010110011 || 11001100110110011100000000111100101010000000010110

r = 11001100101100111100110011011001110000000011110010101000000010110

10. Final Output (HMAC Tag 't'):

- To generate a binary string of size 2l for r, and given that l = 8, the size of r should be 2 * 8 = 16 bits.

  Here's a binary string of size 16 bits that you can use for r:

  Binary String (16 bits): **r = 1100110010110011**

- Now , **Hashed Value = 00001000**

  If 00001000 is the hashed value obtained from inputting the value of r into the hash function, then this hashed value represents the final HMAC tag, which is your "Final Output."

- **Final Output (t): 00001000**

  You should enter 00001000 in the "Final Output" field to complete the HMAC computation. This is the final HMAC tag derived from the given process.

SIMULATION :

A simulator for SHA-1

Plaintext (string):

test

SHA-1

Hash output(hex):

a94a8fe5ccb19ba61c4c0873d391e987982fbbd3

HMAC Construction using a "Dummy" Hash Function

HMAC construction

Plaintext: 1100000000111100101010

Next Plaintext

length of Initialization Vector (IV), l, 8

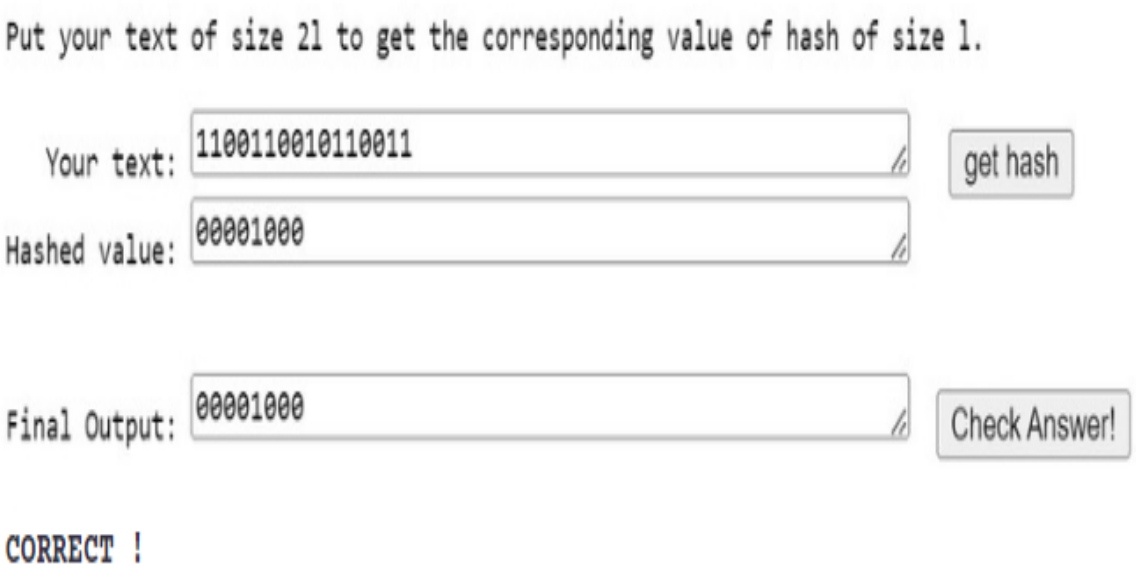
IV: 11001100

Next IV

Key, k: 10000101

Next Key

ipad: 0x5C (01011100)
opad: 0x36 (00110110)



HASHING - SEED UBUNTU

1. Generate a Private Key:

Command : **openssl genpkey -algorithm RSA -out private_key.pem -aes256**

```
[08/26/24]seed@VM:~$ openssl genpkey -algorithm RSA -out private_key.pem -aes256
.......+++++
.........................+++++
Enter PEM pass phrase:
Verifying - Enter PEM pass phrase:
```

2. Extract the Public Key:

Next, extract the public key from the private key:

Command : **openssl rsa -pubout -in private_key.pem -out public_key.pem**

```
[08/26/24]seed@VM:~$ openssl rsa -pubout -in private_key.pem -out public_key.pem
Enter pass phrase for private_key.pem:
writing RSA key
```

3. Create or Obtain the Plaintext File:

Create or obtain the message you want to sign. For this example, create a file named plaintext.txt:

Command : **touch plaintext.txt**

```
[08/26/24]seed@VM:~$ touch plaintext.txt
[08/26/24]seed@VM:~$
```

4. Sign the Message Using the Private Key :

Generate a digital signature for plaintext.txt.This command creates a SHA-256 hash of plaintxt.txt, signs it with your private key, and saves the signature in signature.bin.

Command : **openssl dgst -sha256 -sign private_key.pem -out signature.bin plaintext.txt**

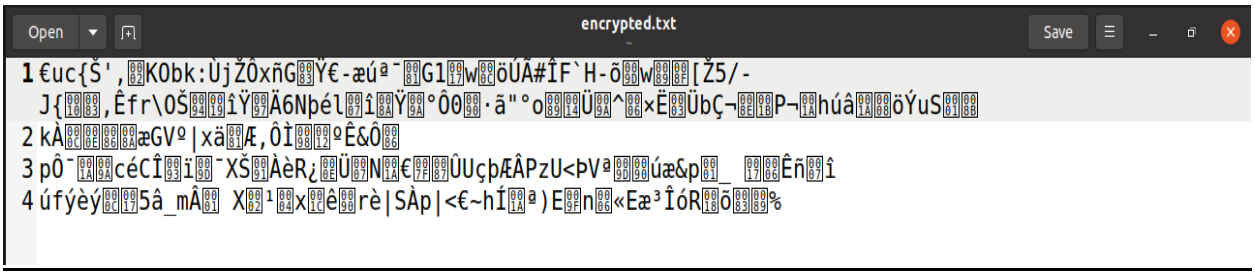
```
[08/26/24]seed@VM:~$ openssl dgst -sha256 -sign private_key.pem -out signature.b
in plaintext.txt
Enter pass phrase for private_key.pem:
```

5. Encrypt the Message Using the Public Key

Encrypt the plaintxt.txt file using the public key:

Command : **openssl rsautl -encrypt -inkey public_key.pem -pubin -in plaintext.txt -out encrypted.bin**

```
[08/26/24]seed@VM:~$ openssl rsautl -encrypt -inkey public_key.pem -pubin -in pl
aintext.txt -out encrypted.bin
[08/26/24]seed@VM:~$
```



6. Decrypt the Message Using the Private Key

Decrypt the encrypted.bin file using the private key. This decrypts the encrypted.bin file using the private key and saves the decrypted content in decrypted.txt.

Command : **openssl rsautl -decrypt -inkey private_key.pem -in encrypted.bin -out decrypted.txt**

```
[08/26/24]seed@VM:~$  openssl rsautl -decrypt -inkey private_key.pem -in encrypt
ed.bin -out decrypted.txt
Enter pass phrase for private_key.pem:
```

7. Verify the Signature Using the Public Key

Finally, verify that the signature matches the original plaintxt.txt file: **Verified OK**

Command : **openssl rsa -pubout -in private_key.pem -out public_key.pem**

```
[08/26/24]seed@VM:~$ openssl rsa -pubout -in private_key.pem -out public_key.pem
Enter pass phrase for private_key.pem:
writing RSA key
```

Command : **openssl dgst -sha256 -verify public_key.pem -signature signature.bin plaintxt.txt**

```
[08/26/24]seed@VM:~$ openssl dgst -sha256 -verify public_key.pem -signature sign
ature.bin file_to_sign.txt
Verified OK
```