Unit - 1

Que.

Q1 :- Explain the OSI Security Architecture & Define a different Security services?

(7M)

Q2 :- What is difference bet^n Substitution Encryption techniques and Transposition Encryption Techniques?

(6M)

Q3 :- Explain the substitution Techniques? If the cipher is keyed by a word "COMPUTER" and plaintext is "Please transfer one million dollars to my account six six two obtain the cipher text by Playfair substitution Method.

(7M)

Q4 :- What is cryptography? Explain the conventional Encryption model with neat diagram?

(6M)

Q5 :- Explain the OSI Security Architecture and Security attacks with example.

(8M)

Q6 :- Explain the various aspects of Information Security.

(5M)

Q7 :- Explain cryptanalysis and its types.

(5M)

Unit - I

Introduction :-

- Attributes of security
- OSI security Architecture ← security Attack, security mechanism, security service.
- Model for Network security

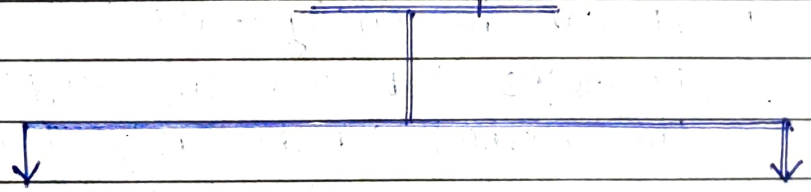
Mathematics of cryptography :-

- Modular Arithmetic
- Euclidean and extended Euclidean algorithm

classical encryption techniques :-

- Substitution techniques
  1) ceasar cipher
  2) Vigeneres ciphers
  3) Hill ciphers
  4) Playfair ciphers
- Transposition techniques.

→ **classical Encryption Techniques**



Substitution Technique	Transposition Technique
(1) Caesar cipher	(1) Rail Fence
(2) Monoalphabetic substitution	(2) Row column Transposition.
(3) Playfair cipher	
(4) Hill cipher	
(5) Polyalphabetic cipher	
(6) one Time pad.	

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Substitution techniques :-

1) Caesar cipher
2) Vigener's cipher
3) Hill ciphers
4) Playfair ciphers
5) one pad.

① Caesar cipher or additive cipher or shift cipher Caesar's code or caesar shift :-

Features of Caesar cipher Substitution Technique :-

① Stream cipher
② Substitution cipher
③ monoalphabetic cipher

Disadvantage of Caesar Cipher :-

① It can be easily hacked.
It means that message encrypted by this method can be easily decrypted.

② It provides very little security

③ By looking at the pattern of letters in it, the entire message can be decrypted.

Advantages of caesar cipher :-

① one of the simplest and easiest encryption methods that provide a layer of security to your data.

Q. Use additive cipher with key = 4 to encrypt message "Hello".

message : Hello
key : 4

⇒

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

P	Q	R	S	T	U	V	W	X	Y	Z
15	16	17	18	19	20	21	22	23	24	25.

Plaintext :- H E LL O key :- 4

↓ ↓ ↓ ↓ ↓

7 4 11 11 14

Encryption of HELLO :

$C = (P+K) \bmod 26$

$C = (H+4) \bmod 26$

$C = (7+4) \bmod 26$

$C = (11) \bmod 26$

$\boxed{C = 11}$ → L

$C = (P+K) \bmod 26$

$C = (E+4) \bmod 26$

$C = (4+4) \bmod 26$

$C = 8 \bmod 26$

$\boxed{C = 8}$ → I

Decryption of cipher text : LIPPS

$P = (C-K) \bmod 26$

$P = (L-4) \bmod 26$

$P = (11-4) \bmod 26$

$P = 7 \bmod 26$

$\boxed{P = 7}$ → H

$P = (C-K) \bmod 26$

$P = (I-4) \bmod 26$

$P = (8-4) \bmod 26$

$P = 4 \bmod 26$

$\boxed{P = 4}$ → E

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$C = (P + K) \bmod 26$
$C = (L + 4) \bmod 26$
$C = (11 + 4) \bmod 26$
$C = 15 \bmod 26$
$\boxed{C = 15}$
↓
P

$C = (P + K) \bmod 26$
$C = (O + K) \bmod 26$
$C = (14 + 4) \bmod 26$
$C = 18 \bmod 26$
$\boxed{C = 18}$
↓
S

$\boxed{\text{Cipher text : LIPPS}}$

$P = (C - K) \bmod 26$
$P = (P - 4) \bmod 26$
$P = (15 - 4) \bmod 26$
$P = 11 \bmod 26$
$\boxed{P = 11}$
↓
L

$P = (C - K) \bmod 26$
$P = (S - 4) \bmod 26$
$P = (18 - 4) \bmod 26$
$P = 14 \bmod 26$
$\boxed{P = 14}$
↓
O

$\boxed{\text{Plaintext : HELLO}}$

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$C = (P + K) \bmod 26$
$C = (L + 4) \bmod 26$
$C = (11 + 4) \bmod 26$
$C = 15 \bmod 26$
$C = 15$
↓
P

$C = (P + K) \bmod 26$
$C = (O + K) \bmod 26$
$C = (14 + 4) \bmod 26$
$C = 18 \bmod 26$
$C = 18$
↓
S

Cipher text : LIPPS

$P = (C - K) \bmod 26$
$P = (P - 4) \bmod 26$
$P = (15 - 4) \bmod 26$
$P = 11 \bmod 26$
$P = 11$
↓
L

$P = (C - K) \bmod 26$
$P = (S - 4) \bmod 26$
$P = (18 - 4) \bmod 26$
$P = 14 \bmod 26$
$P = 14$
↓
O

Plaintext : HELLO

Q. Use Caesar Cipher With key = 14 to encrypt message "TV"

message : TV
key : 14

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

P	Q	R	S	T	U	V	W	X	Y	Z
15	16	17	18	19	20	21	22	23	24	25.

26
52
78
104
130
156
182
208
234
260

Plaintext :- T V key :- 14
↓ ↓
19 21

Encryption of TV :

$C = (P+K) \bmod 26$
$C = (T+K) \bmod 26$
$C = (19+14) \bmod 26$
$C = 33 \bmod 26$

$26 \overline{)33}\ (1$, $33 - 26 = 07$

$\boxed{C = 7}$
↓
H

$C = (P+K) \bmod 26$
$C = (V+K) \bmod 26$
$C = (21+14) \bmod 26$
$C = 35 \bmod 26$

$26 \overline{)35}\ (1$, $35 - 26 = 9$

$\boxed{C = 9}$
↓
J

cipher text : HJ

Decryption of cipher text : HJ

$P = (C-K) \bmod 26$
$P = (H-K) \bmod 26$
$P = (7-14) \bmod 26$
$26 - 7 = 19$
$P = -7 \bmod 26$
$\boxed{P = 19}$
↓
T

$P = (C-K) \bmod 26$
$P = (J-K) \bmod 26$
$P = (9-14) \bmod 26$
$26 - 5 = 21$
$P = -5 \bmod 26$
$\boxed{P = 21}$
↓
V

plaintext : TV

(2) Vigener's cipher :-

(1) It is a poly alphabetic substitution cipher.

→ Plain text : GIVE MONEY
key : LOCK

→

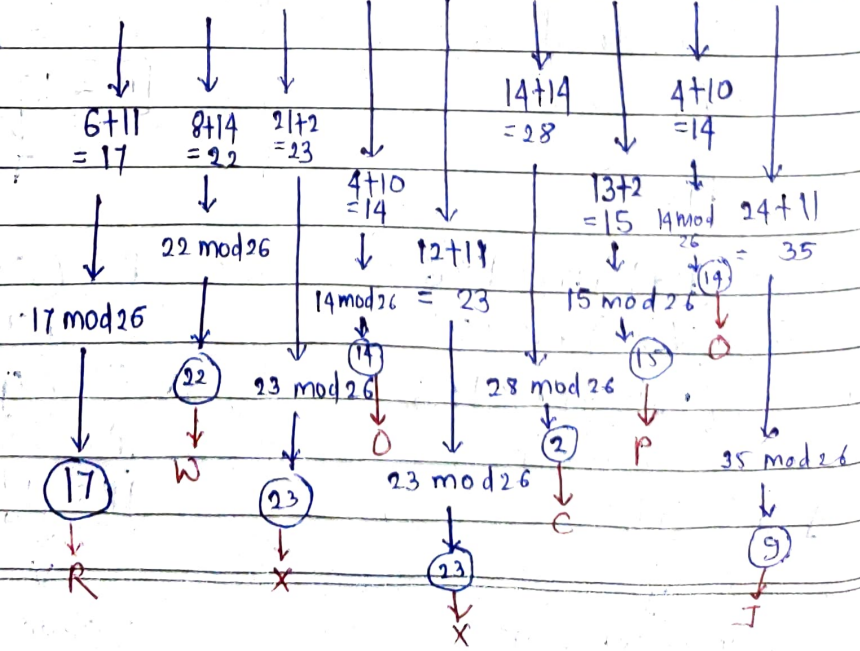
A	B	C	D	E	F	G	H	I	J	K	L
0	1	2	3	4	5	6	7	8	9	10	11

M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
12	13	14	15	16	17	18	19	20	21	22	23	24	25

(1) Encryption :-

Plaintext :	G	I	V	E	M	O	N	E	Y
	↓	↓	↓	↓	↓	↓	↓	↓	↓
	6	8	21	4	12	14	13	4	24

key :	L	O	C	K	L	O	C	K	L
	↓	↓	↓	↓	↓	↓	↓	↓	↓
	11	14	2	10	11	14	2	10	11



Cipher text :- RWXOX CPOJ

decrypt :-

Plaintext :-

G	I	V	E	M	O	N	F	Y
↓	↓	↓	↓	↓	↓	↓	↓	↓
6	8	21	4	12	14	13	4	24

key :	L	O	C	K	L	O	C	K	L
	↓	↓	↓	↓	↓	↓	↓	↓	↓
	11	14	2	10	11	14	2	10	11

Ciphertext :	R	W	X	O	X	C	P	O	J
	(17)	(22)	(23)	(14)	(23)	(2)	(15)	(14)	(9)

$D_i = (E_i - K_i) \bmod 26$
$= (17 - 11) \bmod 26$
$= 6 \bmod 26$
$D_i = 6$ → G

$D_i = (E_i - k_i) \bmod 26$
$= (X - C) \bmod 26$
$= (23 - 2) \bmod 26$
$= 21 \bmod 26$
$D_i = 21$ → V

$D_i = (E_i - k_i) \bmod 26$
$= (W - D) \bmod 26$
$= (22 - 14) \bmod 26$
$= 8 \bmod 26$
$D_i = 8$ → I

$D_i = (E_i - k_i) \bmod 26$
$= (O - K) \bmod 26$
$= (14 - 10) \bmod 26$
$= 4 \bmod 26$
$D_i = 4$ → E

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$D_i = (E_i - k_i) \bmod 26$
$= (X - L) \bmod 26$
$= (23 - 11) \bmod 26$
$= (12 \bmod 26)$
$D_i = 12$
↓
M

$D_i = (E_i - k_i) \bmod 26$
$= (J - L) \bmod 26$
$= (9 - 11) \bmod 26$
$= -2 \bmod 26$
$26 - 2 = 24$
$D_i = 24$
↓
Y

$D_i = (E_i - k_i) \bmod 26$
$= (C - O) \bmod 26$
$= (2 - 14) \bmod 26$
$= -12 \bmod 26$
$26 - 12 = 14$
$D_i = 14$
↓
O

$D_i = (E_i - k_i) \bmod 26$
$= (P - C) \bmod 26$
$= (15 - 2) \bmod 26$
$= 13 \bmod 26$
$D_i = 13$
↓
N

$D_i = (E_i - k_i) \bmod 26$
$= (O - K) \bmod 26$
$= (14 - 10) \bmod 26$
$= 4 \bmod 26$
$D_i = 4$
↓
E

plaintext :- GIVE MONEY

③ Hill cipher :-

Step 1 :- Select message to encrypt.

COMPUTER

Step 2 :- select a key is dbef

Step 3 :- Lets us assign a numerical equivalent

A	B	C	D	E	F	G	H	I	J	K	L	M
0	1	2	3	4	5	6	7	8	9	10	11	12

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
13	14	15	16	17	18	19	20	21	22	23	24	25

Step 4 :- Convert the key dbef to a 2x2 matrix to each.

$$\text{key } K = \begin{bmatrix} d & b \\ g & f \end{bmatrix} = \begin{bmatrix} 3 & 1 \\ 6 & 5 \end{bmatrix}$$

key K is done.

Step 5 :- Convert the message COMPUTER to a n component vector.

$$n = 2 \times 2$$

$$\boxed{n = 2}$$

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$$\begin{bmatrix} C \\ O \end{bmatrix} \begin{bmatrix} M \\ P \end{bmatrix} \begin{bmatrix} U \\ T \end{bmatrix} \begin{bmatrix} E \\ R \end{bmatrix}$$

$$\begin{bmatrix} 2 \\ 14 \end{bmatrix} \begin{bmatrix} 12 \\ 15 \end{bmatrix} \begin{bmatrix} 20 \\ 19 \end{bmatrix} \begin{bmatrix} 4 \\ 17 \end{bmatrix}$$

Encryption

Step 6 :-

ciphertext = K * P mod 26

$$= \begin{bmatrix} 3 & 1 \\ 6 & 5 \end{bmatrix} * \begin{bmatrix} 2 \\ 14 \end{bmatrix} \text{ mod } 26$$

$$= \begin{bmatrix} 3\times2 + 1\times14 \\ 6\times2 + 5\times14 \end{bmatrix} \text{ mod } 26$$

$$= \begin{bmatrix} 6+14 \\ 12+70 \end{bmatrix} \text{ mod } 26$$

$$= \begin{bmatrix} 20 \\ 82 \end{bmatrix} \text{ mod } 26$$

3
26 | 82
-78
04

0
26 | 20
-0
20

= 20 mod 26 ⇒ 20
82 mod 26

$$= \begin{bmatrix} 20 \\ 4 \end{bmatrix}$$

$$= \begin{bmatrix} U \\ E \end{bmatrix}$$

Decryption

Plaintext = $K^{-1} \times C \bmod 26$

↓ (inverse of K)

* inverse of K means inverse of a matrix
* 2x2 matrix means 4 no. ∵ $\begin{bmatrix} - & - \\ - & - \end{bmatrix}$

* $K^{-1} = \frac{1}{|K|} adj(K)$

↓ adjoint

Compute $\frac{1}{|K|}$

⇒ $K = \begin{vmatrix} 3 & 1 \\ 6 & 5 \end{vmatrix} = |3 \times 5 - 6 \times 1| = |15 - 6| = 9$

Rule $a \bmod b = 1$

GCD $(a, b) = 1$

$9 \bmod 26$

$9 \times 1 \bmod 26$

$9 \bmod 26 \Rightarrow 9$

$\frac{1}{|K|} = 3$

$9 \times 2 \bmod 26$

$18 \bmod 26 \Rightarrow 18$

∵ $8 \times 1 \bmod 26$

$8 \bmod 26$

$26 \overline{)27}\ (1$

26

01

$9 \times 3 \bmod 26$

$27 \bmod 26 \Rightarrow 1$

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compute adj(k)

$$K = \begin{bmatrix} 3 & 1 \\ 6 & 5 \end{bmatrix}$$

$$= \begin{bmatrix} 5 & -1 \\ -6 & 3 \end{bmatrix}$$

$$K^{-1} = \frac{1}{|K|} \text{adj}(K) \longrightarrow \text{formula}$$

$$K^{-1} = 3 * \begin{bmatrix} 5 & -1 \\ -6 & 3 \end{bmatrix}$$

$$K^{-1} = \begin{bmatrix} 3x5 & 3x-1 \\ 3x-6 & 3x3 \end{bmatrix}$$

$$K^{-1} = \begin{bmatrix} 15 & -3 \\ -18 & 9 \end{bmatrix}$$

To avoid -ve no just add +26 to negative no.

$$K^{-1} = \begin{bmatrix} 15 & -3+26 \\ -18+26 & 9 \end{bmatrix}$$

$$K^{-1} = \begin{bmatrix} 15 & 23 \\ 8 & 9 \end{bmatrix}$$

then decryption formula

$$\text{Plaintext} = k^{-1} \times C \bmod 26$$

$$= \begin{bmatrix} 15 & 23 \\ 8 & 9 \end{bmatrix} \times \begin{bmatrix} U \\ E \end{bmatrix} \bmod 26$$

$$= \begin{bmatrix} 15 & 23 \\ 8 & 9 \end{bmatrix} \times \begin{bmatrix} 20 \\ 4 \end{bmatrix} \bmod 26$$

$$= \begin{bmatrix} 15 \times 20 + 23 \times 4 \\ 8 \times 20 + 9 \times 4 \end{bmatrix}$$

$$= \begin{bmatrix} 300 + 92 \\ 160 + 36 \end{bmatrix}$$

$$= \begin{bmatrix} 392 \\ 196 \end{bmatrix} \bmod 26$$

$$= 392 \bmod 26$$
$$196 \bmod 26$$

$$= \begin{bmatrix} 2 \\ 14 \end{bmatrix}$$

$$= \begin{bmatrix} C \\ O \end{bmatrix}$$

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④ Playfair cipher :-

→ ① Aka Playfair square or Wheatstone - playfair cipher.

② Manual symmetric encryption technique.
③ First literal diagram substitution cipher
④ Invented in 1854 by Charles Wheatstone
⑤ Bore the name of Lord playfair for promoting its use.

→ ① Multiple letter encryption cipher
② Digrams
③ 5 x 5 matrix constructed using a keywor

→ Rules for encryption Using Playfair cipher.

① Digrams
② Repeating letters - filler letter
③ same column |↓| wrap around
④ same row |→| wrap around
⑤ Rectangle |⇆| swap.

Plaintext → attack
Digrams → at ta ck

Plaintext → neso academy
Digrams → ne so ac ad em yx

Plaintext → balloon
ba ll oo n ⇒ filler letter x

ba lx lo on.

Ex., cipher is keyed by a word COMPUTER.

C	O	M	P	U
T	E	R	A	B
D	F	G	H	I/J
K	L	N	Q	S
V	W	X	Y	Z

5 x 5

Plaintext :- CNSHCI
Digram :-

CN	SH	CI
KM	QI	DU