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**Algorithm: Encryption**

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**Input** : Original Message

**Output:** Cipher Message

Step 1: If original message is a text

Read the original message as  $C \rightarrow (C_0, C_1, \dots, C_{m-1})$

Else

Convert Image to pixel matrix as  $C \rightarrow C[m \times m]$

Step 2: Generate random keys i.e.,

Tetrahedral-based Secret key,  $T_s \rightarrow \{T_{s0}, T_{s1}, \dots, T_{s(m-1)}\}$

Pentatope-based Secret key,  $P_s \rightarrow \{P_{s0}, P_{s1}, \dots, P_{s(m-1)}\}$

Step 3: For  $j = 0$  to  $m - 1$  do upto step 7

Step 4: If C is a text

Convert to ascii value of each character

$$C_{aj} \leftarrow ASCII(C_j)$$

Else

Matrix as  $C_{aj}[m \times m] \leftarrow C[m \times m]$

Step 5: Perform Binomial Coefficient on ASCII of the original message/ on the matrix

$$BO_j \leftarrow C_{aj} \oplus T_{sj}$$

Step 6: Apply homomorphic operations on  $BO_j$

$$HO_1 : DH_j \leftarrow Div(BO_j, P_{sj})$$

$$HO_2 : MH_j \leftarrow mod(BO_j, P_{sj})$$

Step 7: Concatenate the result of homomorphic operations as shown below

If C is text

$$CM_t \leftarrow Concat(f, DH_j, r, MH_j)$$

Else

$$CM_j \leftarrow Concat(f, DH_i, r, MH_i)$$

$$CM_t[m \times m] \leftarrow [CM_j]_{m \times m}$$

Step 8: If C is text

The final result is a cipher Message ( $CM_t$ ).

Else

Convert to cipher image ( $CM_t[m \times m]$ ).

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**Algorithm: Decryption**

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**Input** : Cipher Message

**Output:** Original Message

Step 1: If Cipher message is a text

Read the cipher message as  $CM_t$ .

Else

Convert Cipher Image to pixel matrix as  $CM_t[m \times m]$

Step 2: Generate random keys i.e.,

Tetrahedral based Secret key,  $T_s \rightarrow \{T_{s0}, T_{s1}, \dots \dots \dots, T_{s(m-1)}\}$

Pentatope based Secret key,  $P_s \rightarrow \{P_{s0}, P_{s1}, \dots \dots \dots, P_{s(m-1)}\}$

Step 3: For  $j = 0$  to  $m - 1$  do upto step 7

Step 4: Extract the substring between  $f_i, r_i$  and  $r_i, f_{i+1}$  i.e.,

$$E_i \leftarrow CM_t[f_j : r_j]$$

$$RE_i \leftarrow CM_t[r_j : f_{j+1}]$$

Step 5: Perform homomorphic operations

$$HO_3 : D_j \leftarrow mul(E_j, P_{sj})$$

$$HO_4 : S_j \leftarrow add(D_j, RE_j)$$

Step 6: Apply Binomial Coefficient and convert it to original message

$$BC_j \leftarrow S_j \oplus T_{sj}$$

$$C_j \leftarrow Ori(BC_j)$$

Step 7: Concatenate the result as shown below

If CM is text

$$C_t \leftarrow Concat(C_j)$$

Else

$$C_t[m \times m] \leftarrow [C_j]_{m \times m}$$

Step 8: If CM is text

The final result is a Original Message  $C_t$ .

Else

Convert matrix  $(CM_t[m \times m])$  to Original image.