12. a. Write a C program to Encrypt the message "meet me at the usual place at ten rather than eight oclock" using the Hill cipher with the key. 9 4 5 7 a. Show your calculations and the result. b. Show the calculations for the corresponding decryption of the ciphertext to recover the original plaintext.

Code:

```
import string

ALPHABET = string.ascii_lowercase

char_to_num = {ch: i for i, ch in enumerate(ALPHABET)}

num_to_char = {i: ch for i, ch in enumerate(ALPHABET)}

def clean(text):

    return ''.join(ch for ch in text.lower() if ch in ALPHABET)

def pad_even(text):

    return text if len(text) % 2 == 0 else text + 'x'

def mat_mul_2x2_vec(K, v):

    return [(K[0][0]*v[0] + K[0][1]*v[1]) % 26,

        (K[1][0]*v[0] + K[1][1]*v[1]) % 26]

def text_to_pairs_nums(text):

    nums = [char_to_num[ch] for ch in text]

    return [(nums[i], nums[i+1]) for i in range(0, len(nums), 2)]

def nums_pairs_to_text(pairs):

    return ''.join(num_to_char[a] + num_to_char[b] for a, b in pairs)

def encrypt(plain, K):

    pairs = text_to_pairs_nums(plain)

    c_pairs = [tuple(mat_mul_2x2_vec(K, list(p))) for p in pairs]

    return nums_pairs_to_text(c_pairs)

def decrypt(cipher, K_inv):

    pairs = text_to_pairs_nums(cipher)

    p_pairs = [tuple(mat_mul_2x2_vec(K_inv, list(p))) for p in pairs]

    return nums_pairs_to_text(p_pairs)
```

```python
# Given key

K = [[9, 4],
    [5, 7]]

 Precomputed inverse modulo 26: [[5,12],[15,25]]

K_inv = [[5, 12],
        [15, 25]]

plaintext = "meet me at the usual place at ten rather than eight oclock"

pt = pad_even(clean(plaintext))

ciphertext = encrypt(pt, K)

recovered = decrypt(ciphertext, K_inv)

print("Sanitized plaintext:", pt)

print("Ciphertext:", ciphertext)

print("Decrypted:", recovered)
```
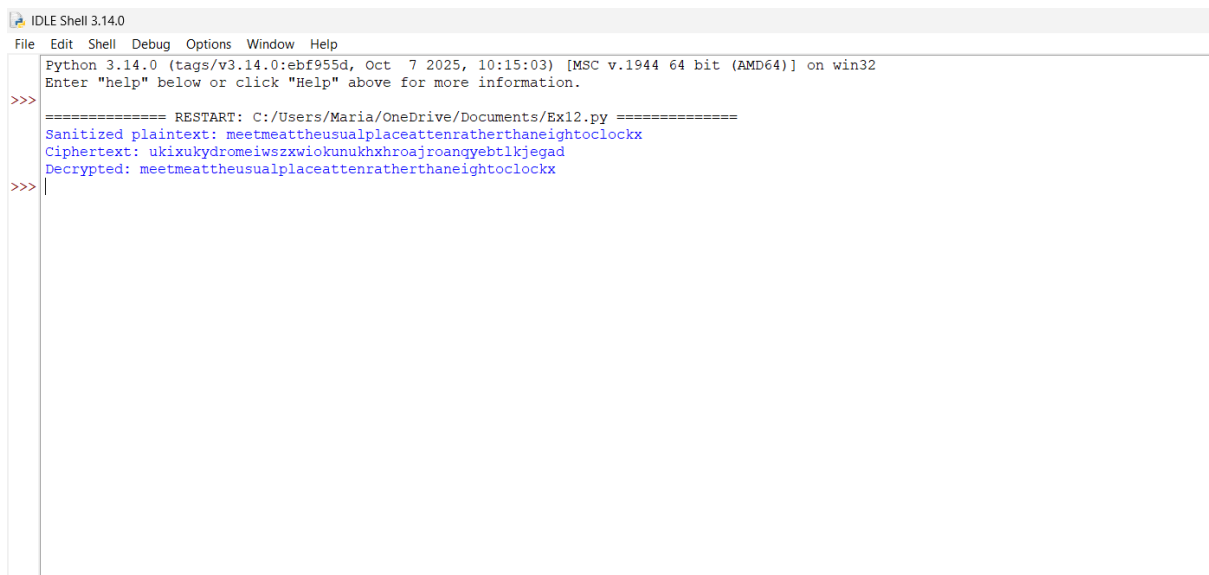
```
IDLE Shell 3.14.0
File  Edit  Shell  Debug  Options  Window  Help
    Python 3.14.0 (tags/v3.14.0:ebf955d, Oct  7 2025, 10:15:03) [MSC v.1944 64 bit (AMD64)] on win32
    Enter "help" below or click "Help" above for more information.
>>>
    ============== RESTART: C:/Users/Maria/OneDrive/Documents/Ex12.py ==============
    Sanitized plaintext: meetmeattheusualplaceattenratherthaneightoclockx
    Ciphertext: ukixukydromeiwszxwiokunukhxhroajroanqyebtlkjegad
    Decrypted: meetmeattheusualplaceattenratherthaneightoclockx
>>>
```