Lab Report

Of

Cryptography

Subject Code: CSC 327

Submitted To

SOCH COLLEGE OF IT

(AFFILIATED TO TRIBHUVAN UNIVERSITY)

Ranipauwa, Pokhara – 11

Submitted By

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Semester: Fifth

List of Exercises

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Faculty Name: **Faculty Signature:**

Lab Administrator Name: **Lab Administrator Signature:**

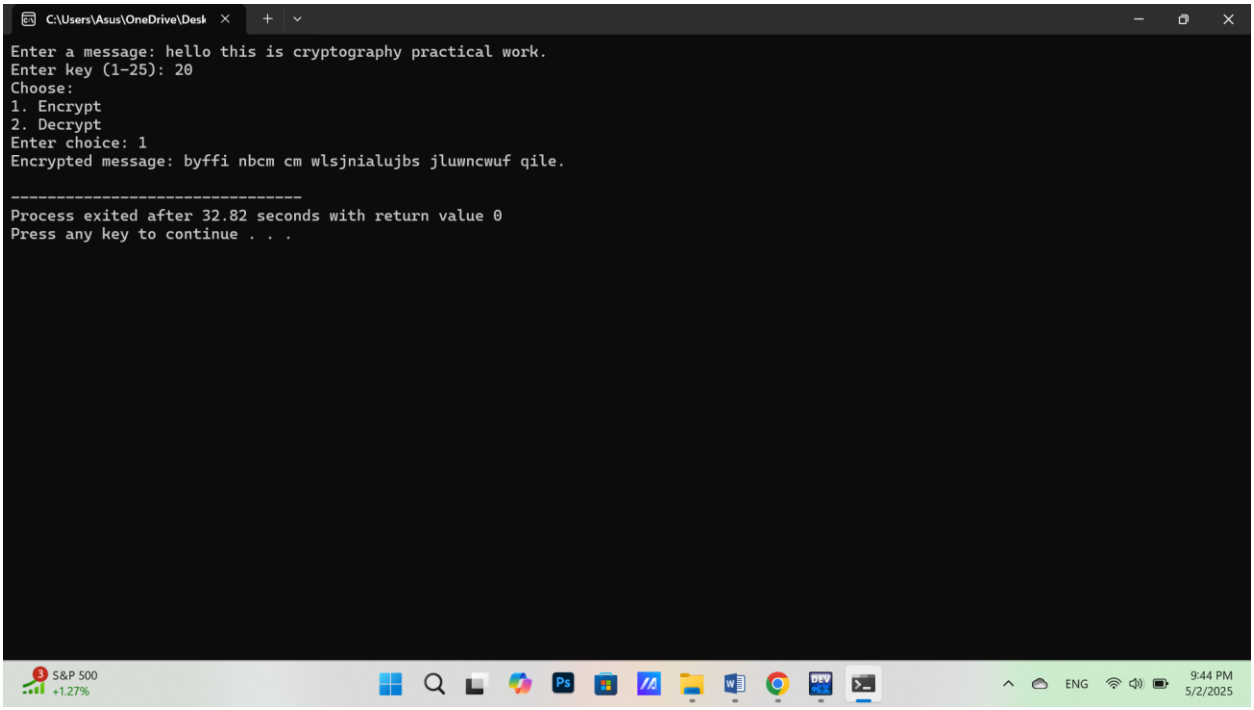
External Examiner Name: **External Examiner Signature:**

Executable Code:

```
#include <stdio.h>
#include <string.h>
#include <ctype.h>

void encrypt(char *message, int key) {
    for (int i = 0; message[i] != '\0'; i++) {
        if (isalpha(message[i])) {
            char base = isupper(message[i]) ? 'A' : 'a';
            message[i] = (message[i] - base + key) % 26 + base;
        }
    }
}

void decrypt(char *message, int key) {
    for (int i = 0; message[i] != '\0'; i++) {
        if (isalpha(message[i])) {
            char base = isupper(message[i]) ? 'A' : 'a';
            message[i] = (message[i] - base - key + 26) % 26 + base;
        }
    }
}

int main() {
    char message[100];
    int key, choice;
```

```
    printf("Enter a message: ");
    fgets(message, sizeof(message), stdin);
    message[strcspn(message, "\n")] = '\0'; // remove newline

    printf("Enter key (1-25): ");
    scanf("%d", &key);
    key = key % 26; // Ensure key is within 0-25

    printf("Choose:\n1. Encrypt\n2. Decrypt\nEnter choice: ");
    scanf("%d", &choice);

    if (choice == 1) {
        encrypt(message, key);
        printf("Encrypted message: %s\n", message);
    } else if (choice == 2) {
        decrypt(message, key);
        printf("Decrypted message: %s\n", message);
    } else {
        printf("Invalid choice.\n");
    }

    return 0;
}
```

Output:


C:\Users\Asus\OneDrive\Desk
Enter a message: hello this is cryptography practical work.
Enter key (1-25): 20
Choose:
1. Encrypt
2. Decrypt
Enter choice: 1
Encrypted message: byffi nbcm cm wlsjnialujbs jluwncwuf qile.

Process exited after 32.82 seconds with return value 0
Press any key to continue . . .
S&P 500
+1.27%
ENG
9:44 PM
5/2/2025

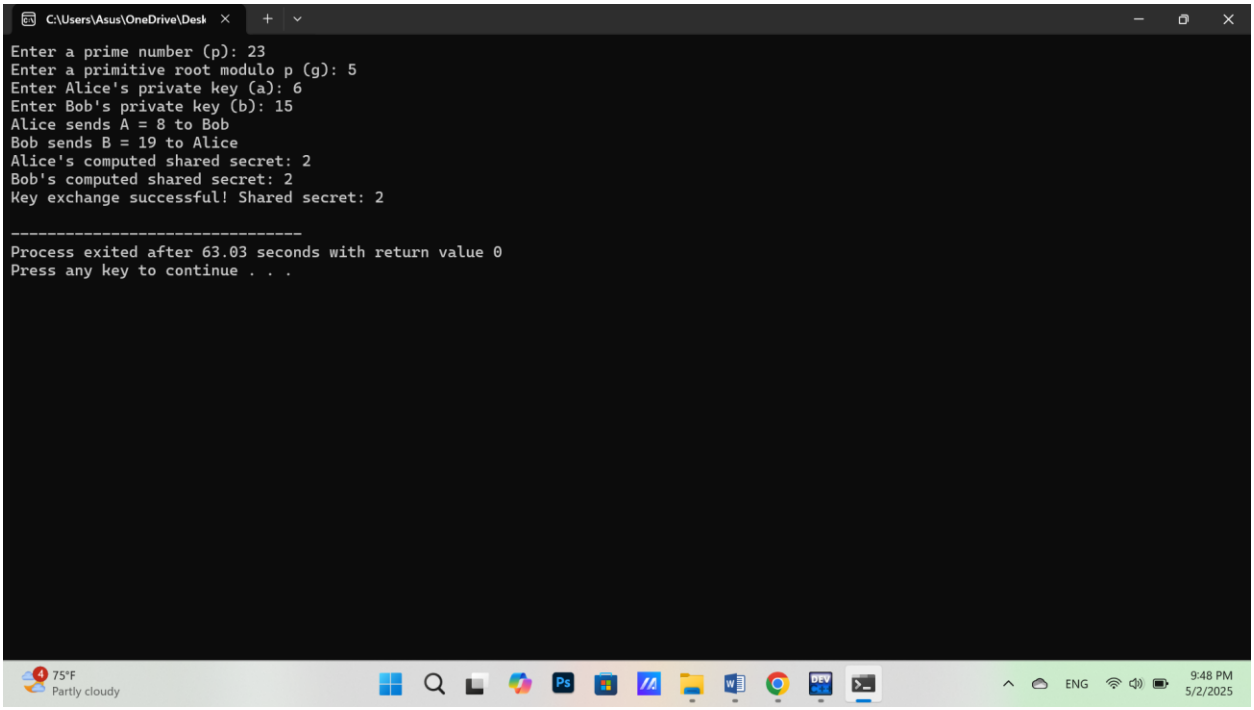
Executable code:

```
#include <stdio.h>
#include <math.h>

// Function to perform modular exponentiation (base^exp % mod)
long long power(long long base, long long exp, long long mod) {
    long long result = 1;
    base = base % mod;
    while (exp > 0) {
        if (exp % 2 == 1) // if exp is odd
            result = (result * base) % mod;
        exp = exp >> 1; // exp = exp / 2
        base = (base * base) % mod;
    }
    return result;
}

int main() {
    long long p, g, a, b, A, B, secretA, secretB;

    // Publicly known values
    printf("Enter a prime number (p): ");
    scanf("%lld", &p);

    printf("Enter a primitive root modulo p (g): ");
    scanf("%lld", &g);
```

```
// Alice's private key
printf("Enter Alice's private key (a): ");
scanf("%lld", &a);

// Bob's private key
printf("Enter Bob's private key (b): ");
scanf("%lld", &b);

// Alice computes A = g^a mod p
A = power(g, a, p);
printf("Alice sends A = %lld to Bob\n", A);

// Bob computes B = g^b mod p
B = power(g, b, p);
printf("Bob sends B = %lld to Alice\n", B);

// Each computes the shared secret
secretA = power(B, a, p); // (B^a) mod p
secretB = power(A, b, p); // (A^b) mod p

printf("Alice's computed shared secret: %lld\n", secretA);
printf("Bob's computed shared secret: %lld\n", secretB);

if (secretA == secretB)
   printf("Key exchange successful! Shared secret: %lld\n", secretA);
else
   printf("Key exchange failed!\n");
```

```
    return 0;
}
```

Output:

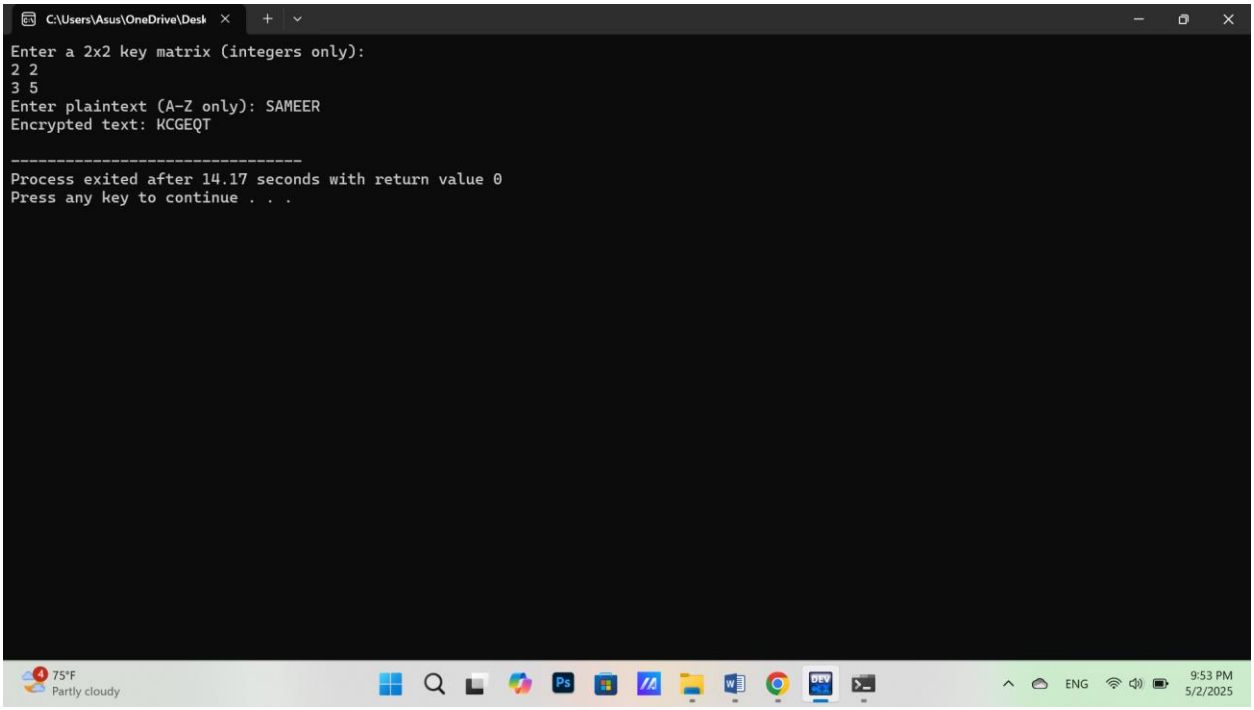


Executable code:

```
#include <stdio.h>
#include <string.h>
#include <ctype.h>

#define SIZE 2

// Function to multiply key matrix and plaintext vector
void encrypt(char plaintext[], int key[SIZE][SIZE]) {
    int i, j, k;
    int len = strlen(plaintext);

    // Make sure length is even (pad with 'X' if odd)
    if (len % 2 != 0) {
        plaintext[len] = 'X';
        plaintext[len + 1] = '\0';
        len++;
    }

    printf("Encrypted text: ");
    for (i = 0; i < len; i += 2) {
        int p[2] = { toupper(plaintext[i]) - 'A', toupper(plaintext[i+1]) - 'A' };
        int c[2] = {0};

        for (j = 0; j < SIZE; j++) {
            for (k = 0; k < SIZE; k++) {
                c[j] += key[j][k] * p[k];
```

```
            }
            c[j] %= 26;
        }

        printf("%c%c", c[0] + 'A', c[1] + 'A');
    }
    printf("\n");
}

int main() {
    char plaintext[100];
    int key[SIZE][SIZE];

    printf("Enter a 2x2 key matrix (integers only):\n");
    for (int i = 0; i < SIZE; i++)
        for (int j = 0; j < SIZE; j++)
            scanf("%d", &key[i][j]);

    printf("Enter plaintext (A-Z only): ");
    scanf("%s", plaintext);

    encrypt(plaintext, key);

    return 0;
}
```

Output:


C:\Users\Asus\OneDrive\Desk
Enter a 2x2 key matrix (integers only):
2 2
3 5
Enter plaintext (A-Z only): SAMEER
Encrypted text: KCGEQT

Process exited after 14.17 seconds with return value 0
Press any key to continue . . .
75°F
Partly cloudy
ENG
9:53 PM
5/2/2025

Executable Code:

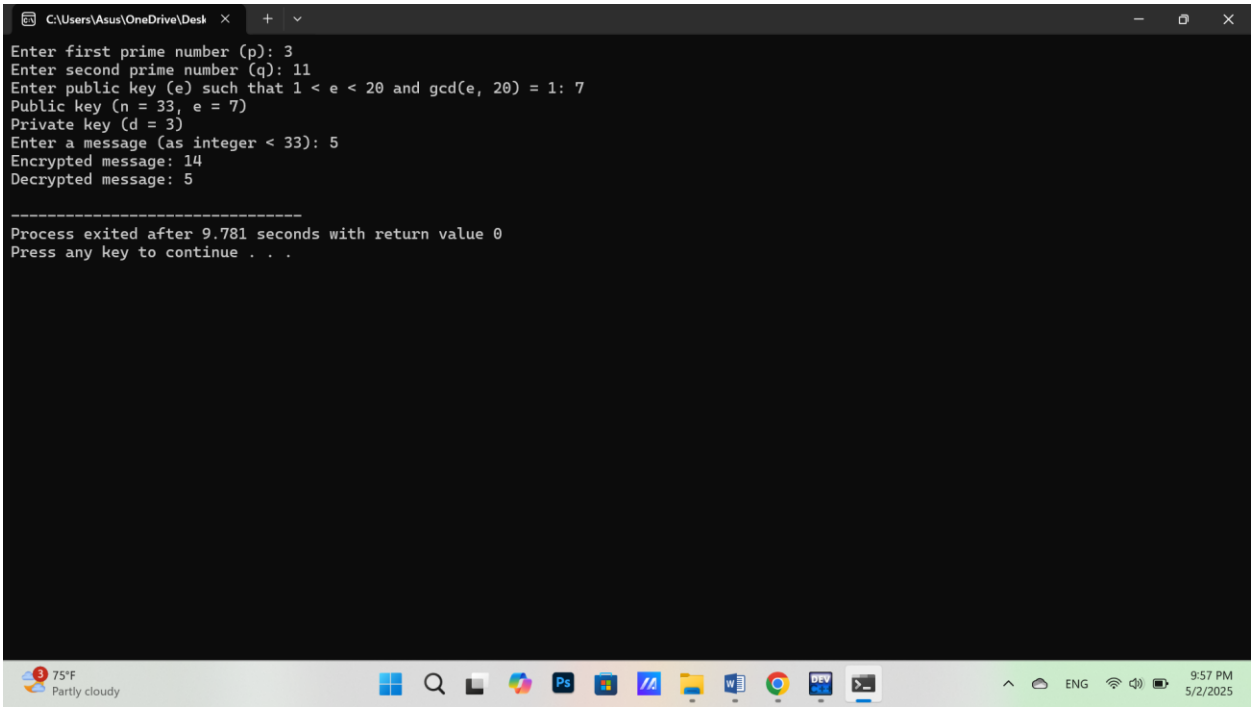
```
#include <stdio.h>

// Function to calculate gcd
int gcd(int a, int b) {
    while (b != 0) {
        int temp = b;
        b = a % b;
        a = temp;
    }
    return a;
}

// Function to find modular inverse of e mod phi (brute-force)
int modInverse(int e, int phi) {
    for (int d = 1; d < phi; d++) {
        if ((e * d) % phi == 1)
            return d;
    }
    return -1;
}

// Function to perform modular exponentiation (base^exp % mod)
long long modExp(long long base, long long exp, long long mod) {
    long long result = 1;
    base = base % mod;
    while (exp > 0) {
```

```
        if (exp % 2 == 1)
            result = (result * base) % mod;
        exp = exp >> 1;
        base = (base * base) % mod;
    }
    return result;
}

int main() {
    int p, q, n, phi, e, d;
    int message;
    long long encrypted, decrypted;

    // Example small prime numbers
    printf("Enter first prime number (p): ");
    scanf("%d", &p);

    printf("Enter second prime number (q): ");
    scanf("%d", &q);

    n = p * q;
    phi = (p - 1) * (q - 1);

    // Choose public key e
    printf("Enter public key (e) such that 1 < e < %d and gcd(e, %d) = 1: ", phi, phi);
    scanf("%d", &e);
```

```
if (gcd(e, phi) != 1) {
    printf("Invalid e. It must be coprime with %d\n", phi);
    return 1;
}

// Calculate private key d
d = modInverse(e, phi);
if (d == -1) {
    printf("Modular inverse for e doesn't exist.\n");
    return 1;
}

printf("Public key (n = %d, e = %d)\n", n, e);
printf("Private key (d = %d)\n", d);

// Message input
printf("Enter a message (as integer < %d): ", n);
scanf("%d", &message);

// Encryption: c = m^e mod n
encrypted = modExp(message, e, n);
printf("Encrypted message: %lld\n", encrypted);

// Decryption: m = c^d mod n
decrypted = modExp(encrypted, d, n);
printf("Decrypted message: %lld\n", decrypted);
```

```
    return 0;
}
```

Output:



Executable Code:

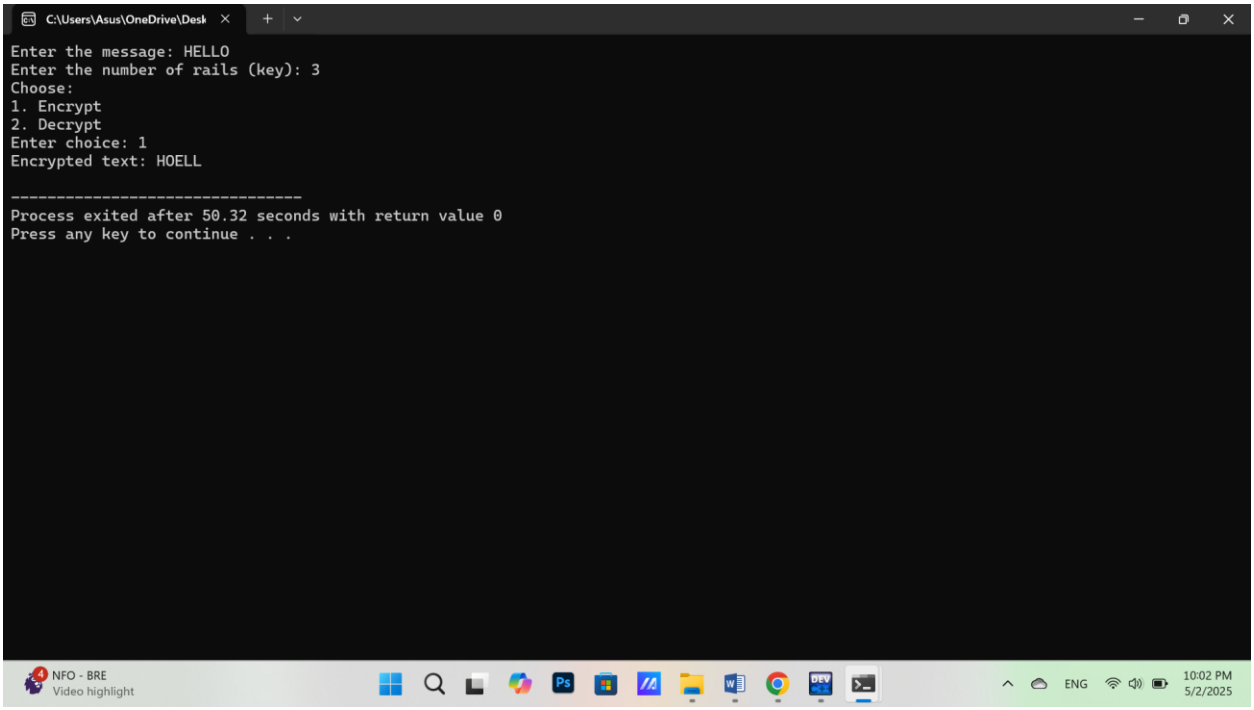
```
#include <stdio.h>
#include <string.h>
#include <stdlib.h>

// Encryption function
void encryptRailFence(char *text, int key) {
    int len = strlen(text);
    char rail[key][len];

    // Filling rail matrix with '\n'
    for (int i = 0; i < key; i++)
        for (int j = 0; j < len; j++)
            rail[i][j] = '\n';

    // To determine the direction
    int row = 0, dir_down = 0;
    for (int i = 0; i < len; i++) {
        // Place character
        rail[row][i] = text[i];

        // Change direction if top or bottom rail
        if (row == 0 || row == key - 1)
            dir_down = !dir_down;

        // Move up or down
        row += dir_down ? 1 : -1;
```

```
    }

    // Read the rail matrix row-wise to get ciphertext
    printf("Encrypted text: ");
    for (int i = 0; i < key; i++)
        for (int j = 0; j < len; j++)
            if (rail[i][j] != '\n')
                printf("%c", rail[i][j]);
    printf("\n");
}

// Decryption function
void decryptRailFence(char *cipher, int key) {
    int len = strlen(cipher);
    char rail[key][len];

    // Fill with '\n'
    for (int i = 0; i < key; i++)
        for (int j = 0; j < len; j++)
            rail[i][j] = '\n';

    // Mark the path with '*'
    int row = 0, dir_down = 0;
    for (int i = 0; i < len; i++) {
        rail[row][i] = '*';

        if (row == 0 || row == key - 1)
```

```
            dir_down = !dir_down;

        row += dir_down ? 1 : -1;
    }

    // Fill the '*' positions with actual ciphertext
    int idx = 0;
    for (int i = 0; i < key; i++)
        for (int j = 0; j < len; j++)
            if (rail[i][j] == '*')
                rail[i][j] = cipher[idx++];

    // Read the matrix in zigzag to reconstruct original message
    printf("Decrypted text: ");
    row = 0;
    dir_down = 0;
    for (int i = 0; i < len; i++) {
        printf("%c", rail[row][i]);

        if (row == 0 || row == key - 1)
            dir_down = !dir_down;

        row += dir_down ? 1 : -1;
    }
    printf("\n");
}
```

```
int main() {
    char message[100];
    int choice, key;

    printf("Enter the message: ");
    scanf("%s", message);

    printf("Enter the number of rails (key): ");
    scanf("%d", &key);

    printf("Choose:\n1. Encrypt\n2. Decrypt\nEnter choice: ");
    scanf("%d", &choice);

    if (choice == 1)
        encryptRailFence(message, key);
    else if (choice == 2)
        decryptRailFence(message, key);
    else
        printf("Invalid choice.\n");

    return 0;
}
```

Output:


C:\Users\Asus\OneDrive\Desk
Enter the message: HELLO
Enter the number of rails (key): 3
Choose:
1. Encrypt
2. Decrypt
Enter choice: 1
Encrypted text: HOELL

Process exited after 50.32 seconds with return value 0
Press any key to continue . . .
NFO - BRE
Video highlight
ENG
10:02 PM
5/2/2025