# Data Structures and Algorithms(UCS540)

## Sixth-Semester

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**3EE2**

**BE Third Year (2021-2025)**

**Electrical Engineering**

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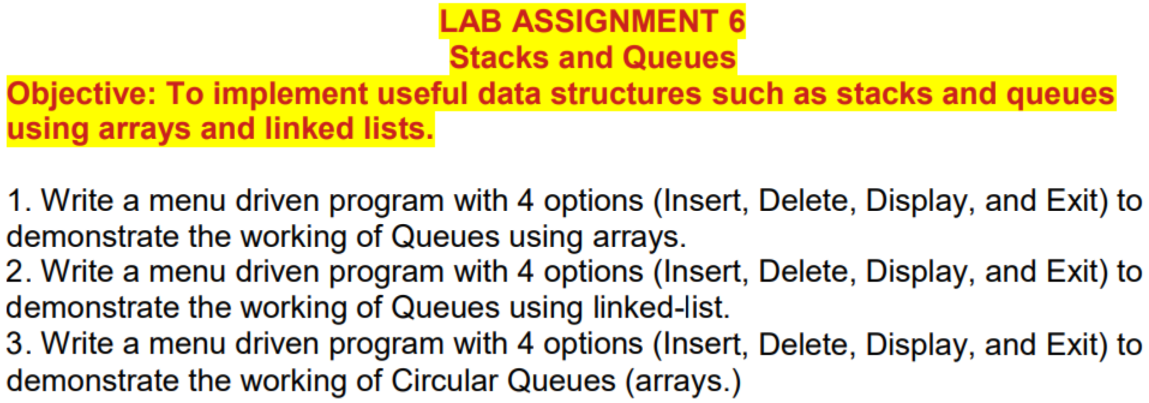
**January-May 2024**

# List of Experiments



**LAB ASSIGNMENT 6**

**Stacks and Queues**

**Objective: To implement useful data structures such as stacks and queues using arrays and linked lists.**

1. Write a menu driven program with 4 options (Insert, Delete, Display, and Exit) to demonstrate the working of Queues using arrays.
2. Write a menu driven program with 4 options (Insert, Delete, Display, and Exit) to demonstrate the working of Queues using linked-list.
3. Write a menu driven program with 4 options (Insert, Delete, Display, and Exit) to demonstrate the working of Circular Queues (arrays.)

## Q1.

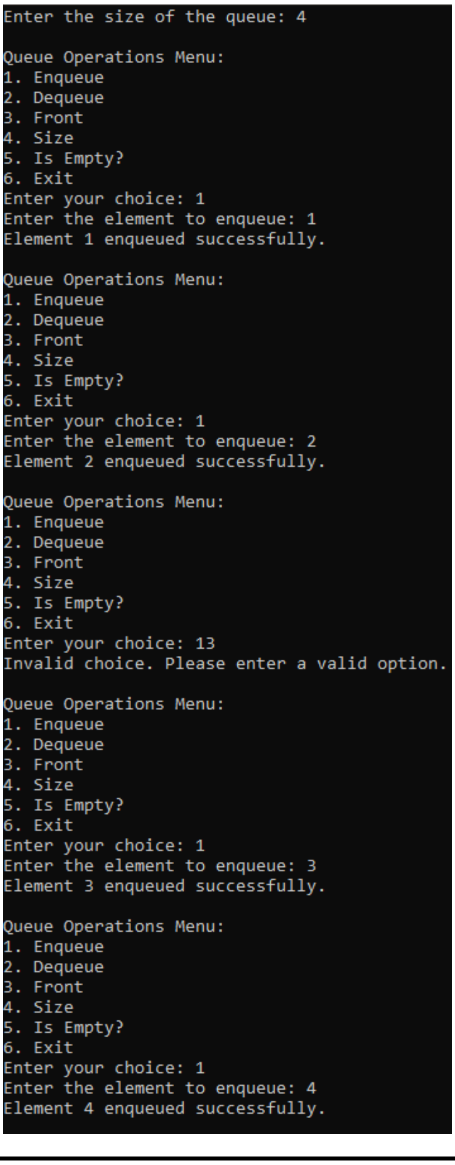
File- “QueueUsingArrays.cpp”

```
#include<iostream>
using namespace std;
template <typename T>
class QueueUsingArrays
{
        T *data;
        int size;
        int front;
        int tail;
        int capacity;

        public:
                QueueUsingArrays(int s)
                {
                        data = new T[s];
                        front = -1;
                        tail = 0;
                        size = 0;
                        capacity = s;
                }

                int getSize()
                {
                        return size;
                }

                bool isEmpty()
                {
                        return size == 0;
                }

                void enqueue(T d)
                {
                        if(size == capacity)
                        {
                        /*cout<<"Queue  is full!"<<endl;
                        return;*/

//                              Dyanamic Queue
                                T *newData = new T[2*capacity];
                                int j = 0;
                                for(int i = front; i<capacity ; i++)
                                {
                                        newData[j] = data[i];
                                        j++;
                                }
                                for(int i = 0; i<capacity; i++)
                                {
                                        newData[j] = data[i];
                                        j++;
                }

                delete [] data;
                data = newData;
                front = 0;
                tail = capacity;
                capacity = 2*capacity;
            }
            if(front == -1)
            {
                front = 0;
            }
            data[tail] = d;
            tail = (tail + 1) % capacity;
            size++;
        }

        T Front()
        {
            if(isEmpty())
            {
                cout<<"Queue is empty!"<<endl;
                return 0;
            }
            return data[front];
        }

        T dequeue()
        {
            if(isEmpty())
            {
                cout<<"Queue is empty!"<<endl;
                return 0;
            }

            T val = data[front];
            data[front] = -1;
            front = (front + 1) % capacity;
            size--;
            if(size == 0)
            {
                front = -1;
                tail = 0;
            }
            return val;
        }
};
```

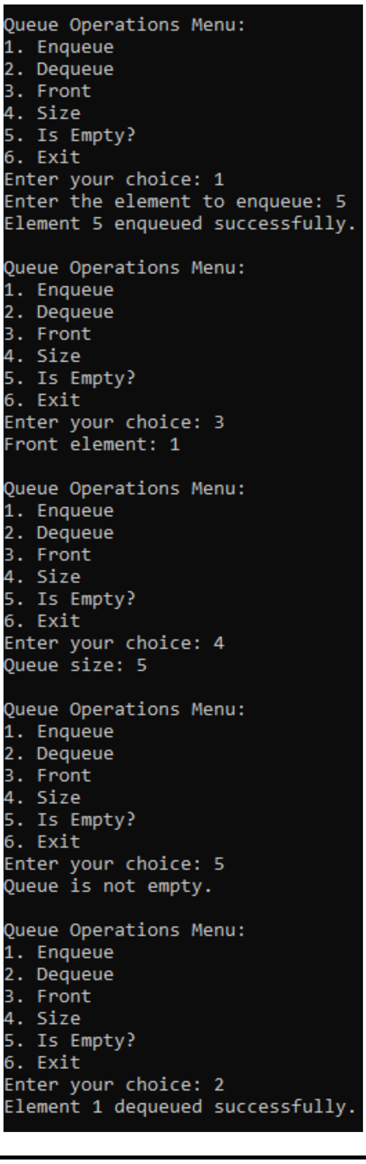
File – “QueueUse.cpp”

```
#include <iostream>
#include "QueueUsingArrays.cpp" // Include the definition of QueueUsingArrays

using namespace std;

int main() {
    int choice, size;
    cout << "Enter the size of the queue: ";
    cin >> size;

    QueueUsingArrays<int> queue(size); // Creating a queue object of integer type

    do {
        cout << "\nQueue Operations Menu:" << endl;
        cout << "1. Enqueue" << endl;
        cout << "2. Dequeue" << endl;
        cout << "3. Front" << endl;
        cout << "4. Size" << endl;
        cout << "5. Is Empty?" << endl;
        cout << "6. Exit" << endl;
        cout << "Enter your choice: ";
        cin >> choice;

        switch (choice) {
            case 1: {
                int element;
                cout << "Enter the element to enqueue: ";
                cin >> element;
                queue.enqueue(element);
                cout << "Element " << element << " enqueued successfully." << endl;
                break;
            }
            case 2: {
                if (!queue.isEmpty()) {
                    int dequeuedElement = queue.dequeue();
                    cout << "Element " << dequeuedElement << " dequeued successfully." << endl;
                } else {
                    cout << "Queue is empty. Cannot dequeue." << endl;
                }
                break;
            }
            case 3: {
                if (!queue.isEmpty()) {
                    cout << "Front element: " << queue.Front() << endl;
                } else {
                    cout << "Queue is empty." << endl;
                }
                break;
            }
            case 4: {
                cout << "Queue size: " << queue.getSize() << endl;
                break;
            }
            case 5: {
                if (queue.isEmpty()) {
                    cout << "Queue is empty." << endl;
                } else {
                    cout << "Queue is not empty." << endl;
                }
                break;
            }
            case 6: {
                cout << "Exiting the program." << endl;
                break;
            }
            default: {
                cout << "Invalid choice. Please enter a valid option." << endl;
            }
        }
    } while (choice != 6);

    return 0;
}
```

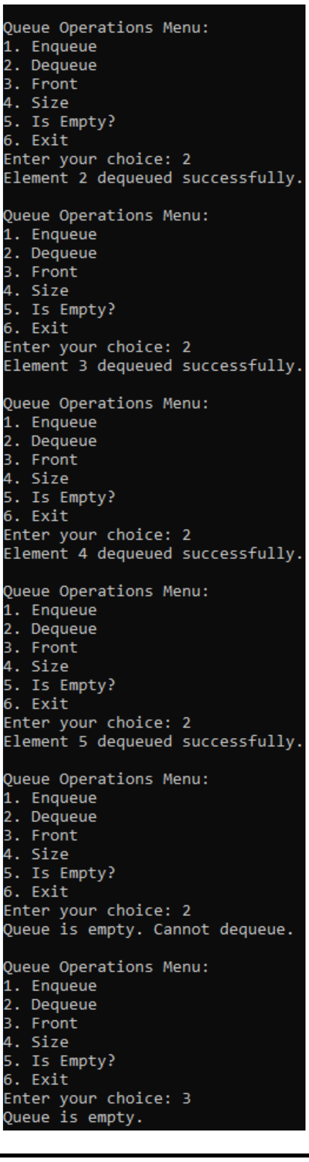
## Output:



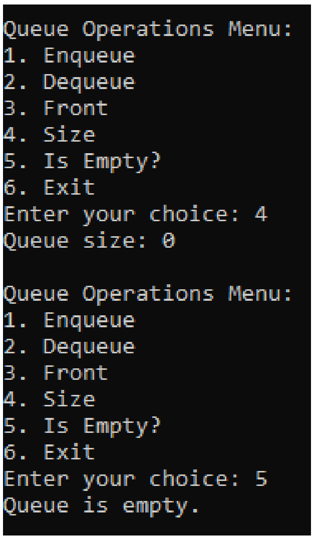
```
Enter the size of the queue: 4

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 1
Enter the element to enqueue: 1
Element 1 enqueued successfully.

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 1
Enter the element to enqueue: 2
Element 2 enqueued successfully.

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 13
Invalid choice. Please enter a valid option.

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 1
Enter the element to enqueue: 3
Element 3 enqueued successfully.

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 1
Enter the element to enqueue: 4
Element 4 enqueued successfully.
```



```
Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 1
Enter the element to enqueue: 5
Element 5 enqueued successfully.

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 3
Front element: 1

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 4
Queue size: 5

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 5
Queue is not empty.

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 2
Element 1 dequeued successfully.
```



```
Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 2
Element 2 dequeued successfully.

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 2
Element 3 dequeued successfully.

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 2
Element 4 dequeued successfully.

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 2
Element 5 dequeued successfully.

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 2
Queue is empty. Cannot dequeue.

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 3
Queue is empty.
```

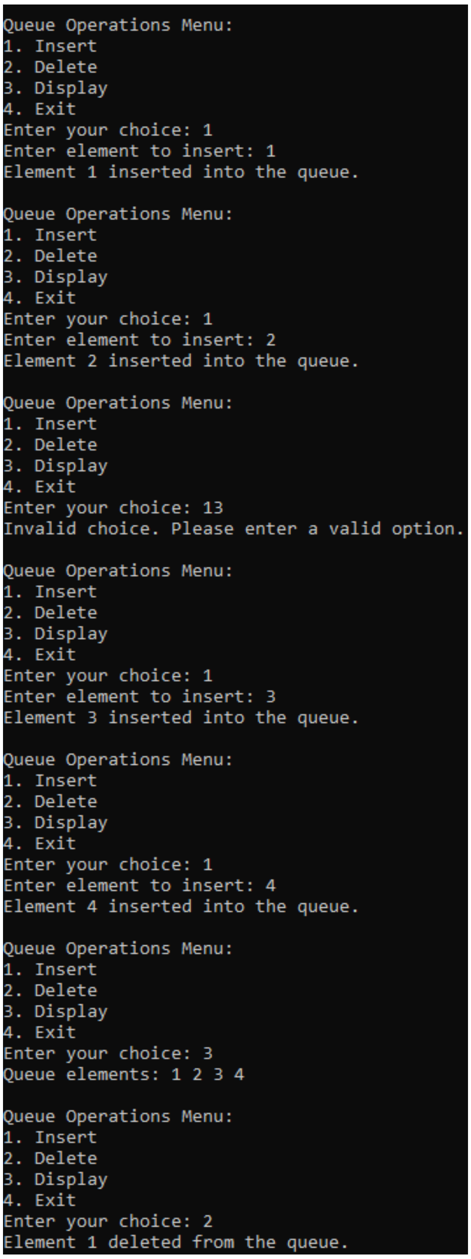


```
Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 4
Queue size: 0

Queue Operations Menu:
1. Enqueue
2. Dequeue
3. Front
4. Size
5. Is Empty?
6. Exit
Enter your choice: 5
Queue is empty.
```

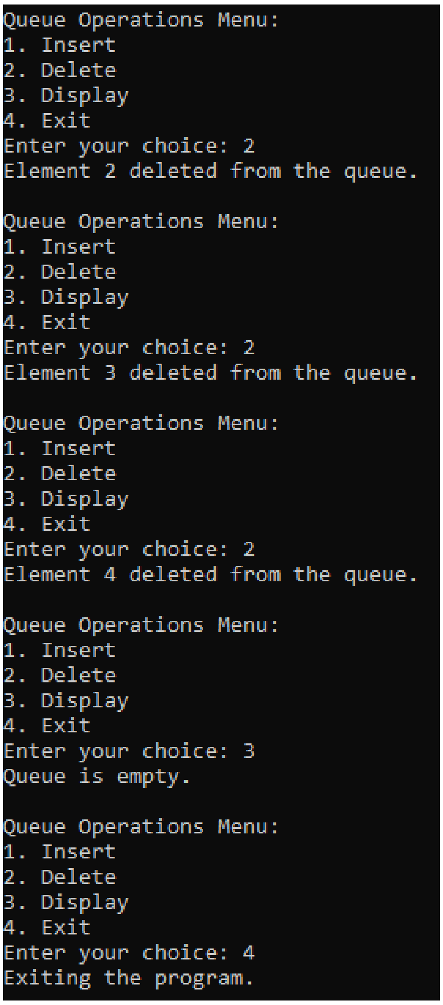
## Q2.

```
#include <iostream>
using namespace std;

class Node {
public:
    int data;
    Node* next;

    Node(int value) {
        data = value;
        next = NULL;
    }
};

class QueueUsingLinkedList {
private:
    Node* front;
    Node* rear;

public:
    QueueUsingLinkedList() {
        front = NULL;
        rear = NULL;
    }

    void insert(int value) {
        Node* newNode = new Node(value);
        if (front == NULL) {
            front = newNode;
            rear = newNode;
        } else {
            rear->next = newNode;
            rear = newNode;
        }
        cout << "Element " << value << " inserted into the queue." << endl;
    }
    void remove() {
        if (front == NULL) {
            cout << "Queue is empty. Cannot delete." << endl;
            return;
        }
        Node* temp = front;
        int deletedValue = temp->data;
        front = front->next;
        delete temp;
        cout << "Element " << deletedValue << " deleted from the queue." << endl;
    }

    void display() {
        if (front == NULL) {
            cout << "Queue is empty." << endl;
            return;
        }
        cout << "Queue elements: ";
        Node* current = front;
        while (current != NULL) {
            cout << current->data << " ";
            current = current->next;
        }
        cout << endl;
    }

    ~QueueUsingLinkedList() {
        Node* temp;
        while (front != NULL) {
            temp = front;
            front = front->next;
            delete temp;
        }
    }
};

int main() {
    QueueUsingLinkedList queue;
    int choice, element;

    do {
        cout << "\nQueue Operations Menu:" << endl;
        cout << "1. Insert" << endl;
        cout << "2. Delete" << endl;
        cout << "3. Display" << endl;
        cout << "4. Exit" << endl;
        cout << "Enter your choice: ";
        cin >> choice;

        switch (choice) {
            case 1:
                cout << "Enter element to insert: ";
                cin >> element;
                queue.insert(element);
                break;
            case 2:
                queue.remove();
                break;
            case 3:
                queue.display();
                break;
            case 4:
                cout << "Exiting the program." << endl;
                break;
            default:
                cout << "Invalid choice. Please enter a valid option." << endl;
        }
    } while (choice != 4);

    return 0;
}
```

## Output:



```
Queue Operations Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to insert: 1
Element 1 inserted into the queue.

Queue Operations Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to insert: 2
Element 2 inserted into the queue.

Queue Operations Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 13
Invalid choice. Please enter a valid option.

Queue Operations Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to insert: 3
Element 3 inserted into the queue.

Queue Operations Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to insert: 4
Element 4 inserted into the queue.

Queue Operations Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Queue elements: 1 2 3 4

Queue Operations Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Element 1 deleted from the queue.
```

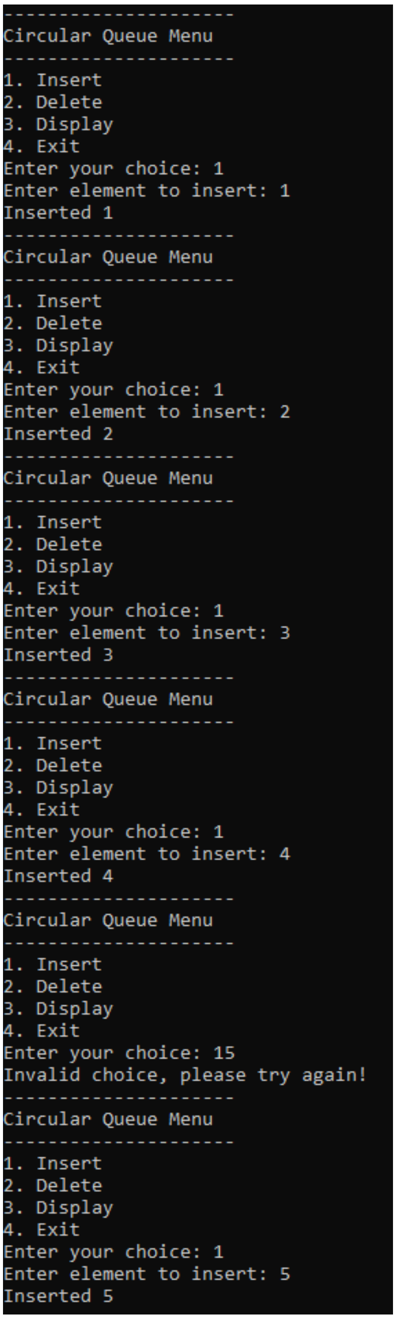


```
Queue Operations Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Element 2 deleted from the queue.

Queue Operations Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Element 3 deleted from the queue.

Queue Operations Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Element 4 deleted from the queue.

Queue Operations Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Queue is empty.

Queue Operations Menu:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 4
Exiting the program.
```

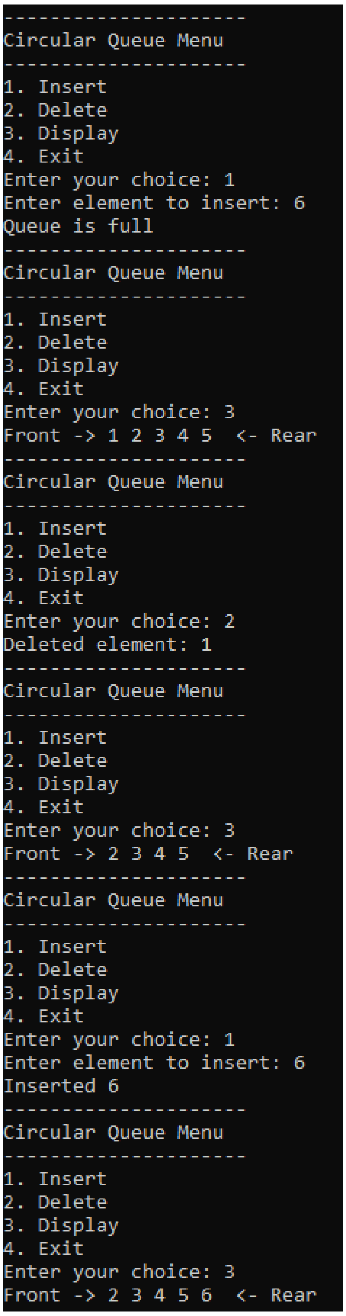
## Q3.

```
#include <iostream>
using namespace std;

#define SIZE 5 // Change the size of the queue as needed

class CircularQueue {
private:
    int items[SIZE], front, rear;

public:
    CircularQueue() {
        front = -1;
        rear = -1;
    }

    bool isFull() {
        if (front == 0 && rear == SIZE - 1)
            return true;
        if (front == rear + 1)
            return true;
        return false;
    }

    bool isEmpty() {
        if (front == -1)
            return true;
        else
            return false;
    }

    void insertElement(int element) {
        if (isFull()) {
            cout << "Queue is full" << endl;
        } else {
            if (front == -1)
                front = 0;
            rear = (rear + 1) % SIZE;
            items[rear] = element;
            cout << "Inserted " << element << endl;
        }
    }

    void deleteElement() {
        int element;
        if (isEmpty()) {
            cout << "Queue is empty" << endl;
        } else {
            element = items[front];
            if (front == rear) {
                front = -1;
                rear = -1;
            } else {
                front = (front + 1) % SIZE;
            }
            cout << "Deleted element: " << element << endl;
        }
    }

    void display() {
        int i;
        if (isEmpty()) {
            cout << "Queue is empty" << endl;
        } else {
            cout << "Front -> ";
            for (i = front; i != rear; i = (i + 1) % SIZE)
                cout << items[i] << " ";
            cout << items[i] << " ";
            cout << " <- Rear" << endl;
        }
    }
};

int main() {
    CircularQueue queue;
    int choice, element;

    do {
        cout << "---------------------" << endl;
        cout << "Circular Queue Menu" << endl;
        cout << "---------------------" << endl;
        cout << "1. Insert" << endl;
        cout << "2. Delete" << endl;
        cout << "3. Display" << endl;
        cout << "4. Exit" << endl;
        cout << "Enter your choice: ";
        cin >> choice;

        switch (choice) {
            case 1:
                cout << "Enter element to insert: ";
                cin >> element;
                queue.insertElement(element);
                break;
            case 2:
                queue.deleteElement();
                break;
            case 3:
                queue.display();
                break;
            case 4:
                cout << "Exiting program..." << endl;
                break;
            default:
                cout << "Invalid choice, please try again!" << endl;
        }
    } while (choice != 4);
    return 0;
}
```

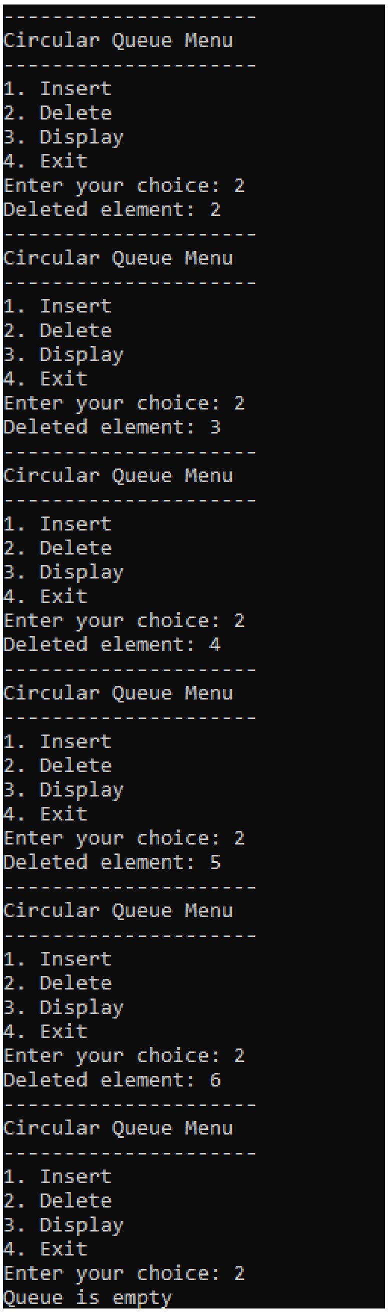
## Output:



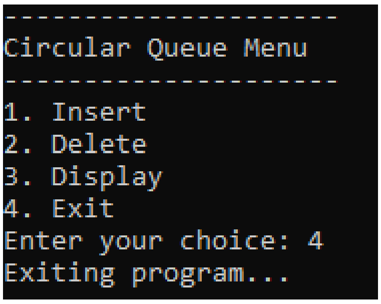
```
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to insert: 1
Inserted 1
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to insert: 2
Inserted 2
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to insert: 3
Inserted 3
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to insert: 4
Inserted 4
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 15
Invalid choice, please try again!
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to insert: 5
Inserted 5
```



```
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to insert: 6
Queue is full
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Front -> 1 2 3 4 5  <- Rear
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted element: 1
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Front -> 2 3 4 5  <- Rear
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to insert: 6
Inserted 6
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Front -> 2 3 4 5 6  <- Rear
```



```
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted element: 2
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted element: 3
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted element: 4
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted element: 5
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted element: 6
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Queue is empty
```



```
--------------------
Circular Queue Menu
--------------------
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 4
Exiting program...
```