Task 2 Odd to Even

Design a quantum algorithm that when given numbers of range [1,n) and are odd convert them into even numbers, and they must stay in the same range so they cannot be less than 1 nor less than n. n = 2^k where k is the number of qubits you are going to use.

References:

[1] Deutsch, David, and Richard Jozsa. "Rapid solution of problems by quantum computation." Proceedings of the Royal Society of London. Series A: Mathematical and Physical Sciences 439.1907 (1992): 553-558. [2] Bernstein, Ethan, and Umesh Vazirani. "Quantum complexity theory." SIAM Journal on computing 26.5 (1997): 1411-1473. [3] Grover, Lov K. , "A fast quantum mechanical algorithm for database search", Proceedings of the 28th Annual ACM Symposium on the Theory of Computing (1996), arXiv:quant-ph/9605043

In [5]:
```
from qiskit import QuantumCircuit,  transpile, assemble
from qiskit.visualization import plot_histogram

def odd_to_even(n):
    qc = QuantumCircuit(n)

    for i in range(1, n, 2):
        qc.x(i)

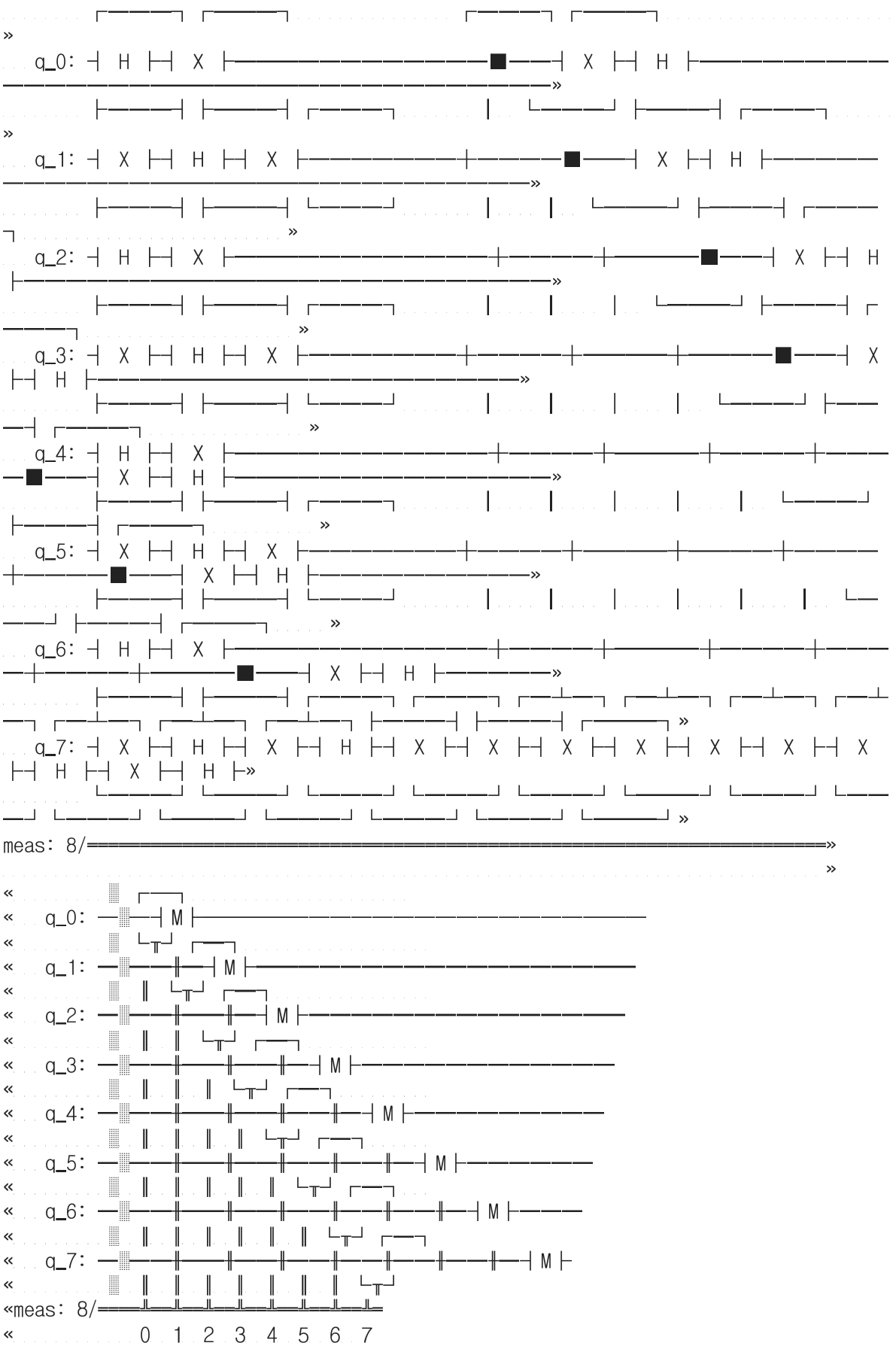

    qc.h(range(n))
    qc.x(range(n))
    qc.h(n-1)

    for qubit in range(n-1):
        qc.cx(qubit, n-1)
    qc.h(n-1)
    qc.x(range(n))
    qc.h(range(n))


    qc.measure_all()

    return qc


n = 8
qc = odd_to_even(n)
print(qc)
```



In [4]:
```
!pip install pylatexenc
```

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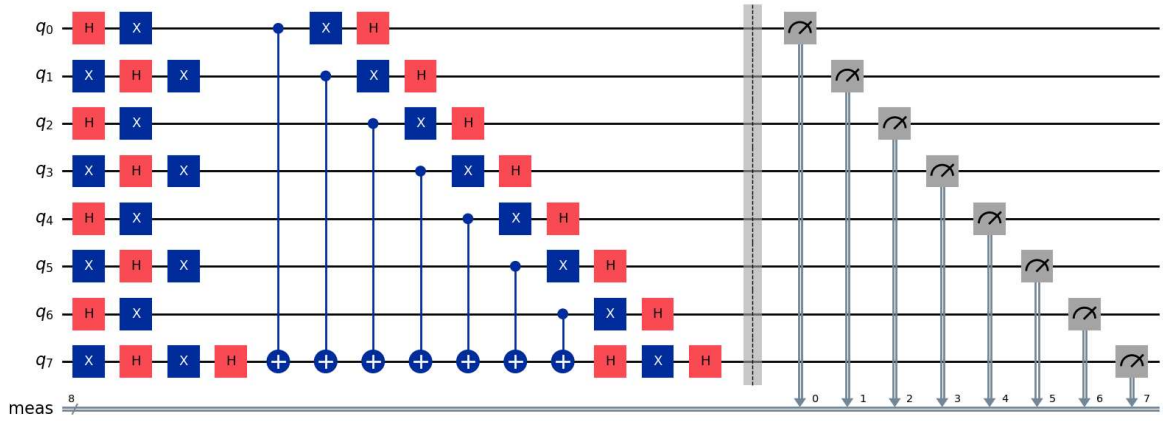
Requirement already satisfied: pylatexenc in c:₩users₩mjdor₩anaconda3₩lib₩site-packa
ges (2.10)
```

In [6]:
```
qc.draw(output='mpl')
```

Out[6]:



Desecription

The given problem is to design a quantum circuit that finds odd numbers and converts them into even numbers. The given range is [1, n), and the numbers must remain within the same range. This problem can be solved using the Grover search algorithm.

The Grover algorithm is used to find the desired state, but the goal here is to find odd numbers. We therefore define an odd-finding oracle and incorporate it into the Grover algorithm. To this end, we implement a multi-controlled Toffoli gate using CX gates to construct an odd-finding oracle. We then incorporate this oracle into an iterative step of Grover to build a quantum circuit that finds odd states and converts them into even numbers.

Thus, the given code implements a quantum circuit that finds odd numbers and converts them into even numbers, and works on the basis of the idea of Grover search algorithms.

In [ ]: