Solution to Problem 3.4.1

We are tasked with inserting the keys $E, A, S, Y, Q, U, T, I, O, N$ into a hash table with $M = 5$ lists using the given hash function:

$$h(k) = (11 \cdot k) \mod M$$

where k is the position of the letter in the alphabet ($A = 1, B = 2, \ldots, Z = 26$).

Step 1: Letter Positions (k)

The position k for each letter is as follows:

$E = 5, \quad A = 1, \quad S = 19, \quad Y = 25, \quad Q = 17, \quad U = 21, \quad T = 20, \quad I = 9, \quad O = 15, \quad N = 14$

Step 2: Applying the Hash Function

We compute $h(k) = (11 \cdot k) \mod 5$ for each letter:

Letter	k (Position)	$h(k) = (11 \cdot k) \mod 5$	Hash Index
E	5	$(11 \cdot 5) \mod 5 = 55 \mod 5 = 0$	0
A	1	$(11 \cdot 1) \mod 5 = 11 \mod 5 = 1$	1
S	19	$(11 \cdot 19) \mod 5 = 209 \mod 5 = 4$	4
Y	25	$(11 \cdot 25) \mod 5 = 275 \mod 5 = 0$	0
Q	17	$(11 \cdot 17) \mod 5 = 187 \mod 5 = 2$	2
U	21	$(11 \cdot 21) \mod 5 = 231 \mod 5 = 1$	1
T	20	$(11 \cdot 20) \mod 5 = 220 \mod 5 = 0$	0
I	9	$(11 \cdot 9) \mod 5 = 99 \mod 5 = 4$	4
O	15	$(11 \cdot 15) \mod 5 = 165 \mod 5 = 0$	0
N	14	$(11 \cdot 14) \mod 5 = 154 \mod 5 = 4$	4

Step 3: Hash Table with Separate Chaining

Using separate chaining, the hash table is as follows:

Index	Keys (Chained)
0	E, Y, T, O
1	A, U
2	Q
3	(Empty)
4	S, I, N

Explanation

- The keys are inserted into the hash table based on their hash index computed using the given hash function $h(k)$. - Collisions (keys mapping to the same index) are handled using separate chaining, where multiple keys are stored in a linked list at the corresponding index.