

Arithmetic Division (Restoring and Non-Restoring Methods)

-Mitali Desai

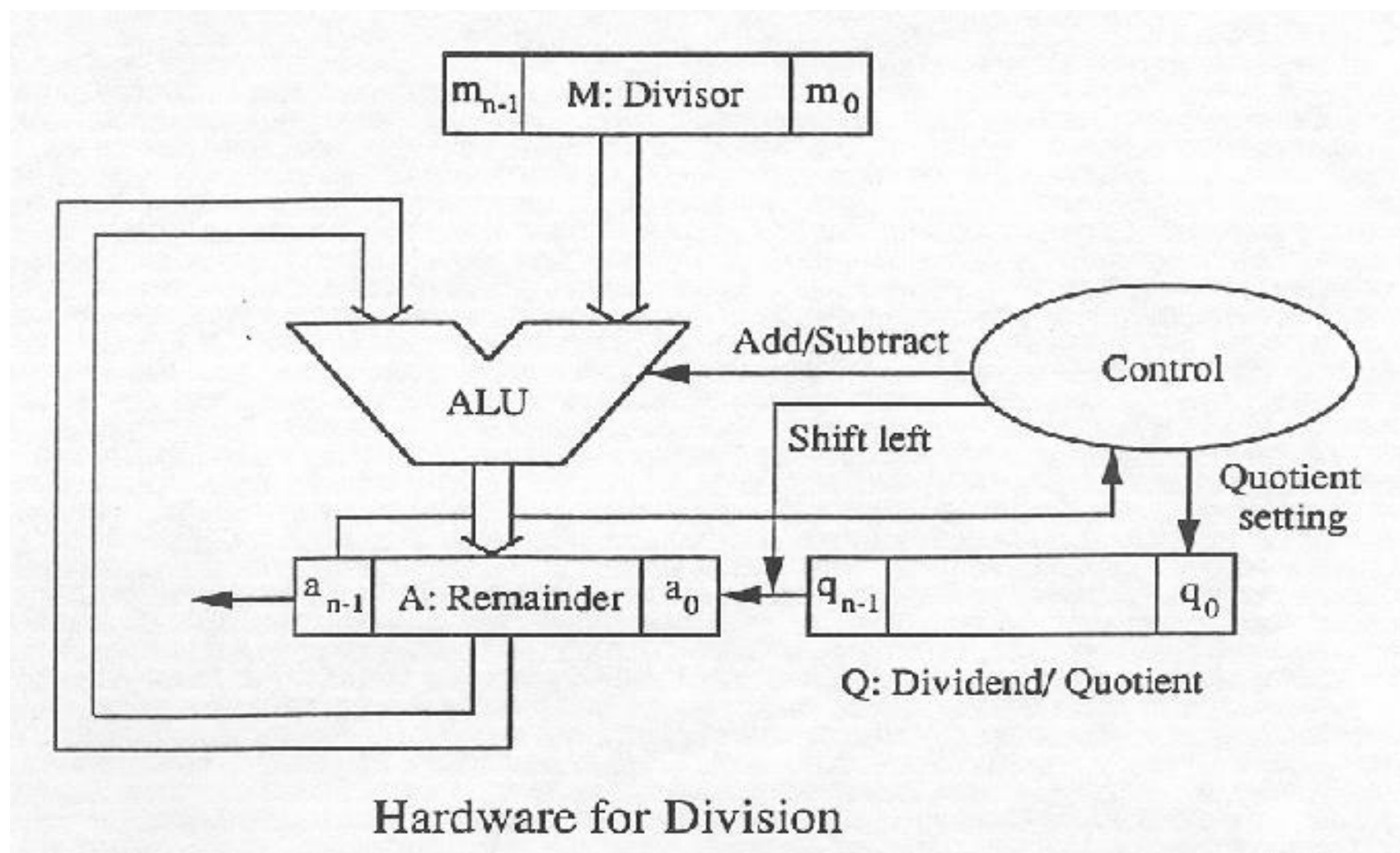
Binary Division: Pen and Paper

Decimal

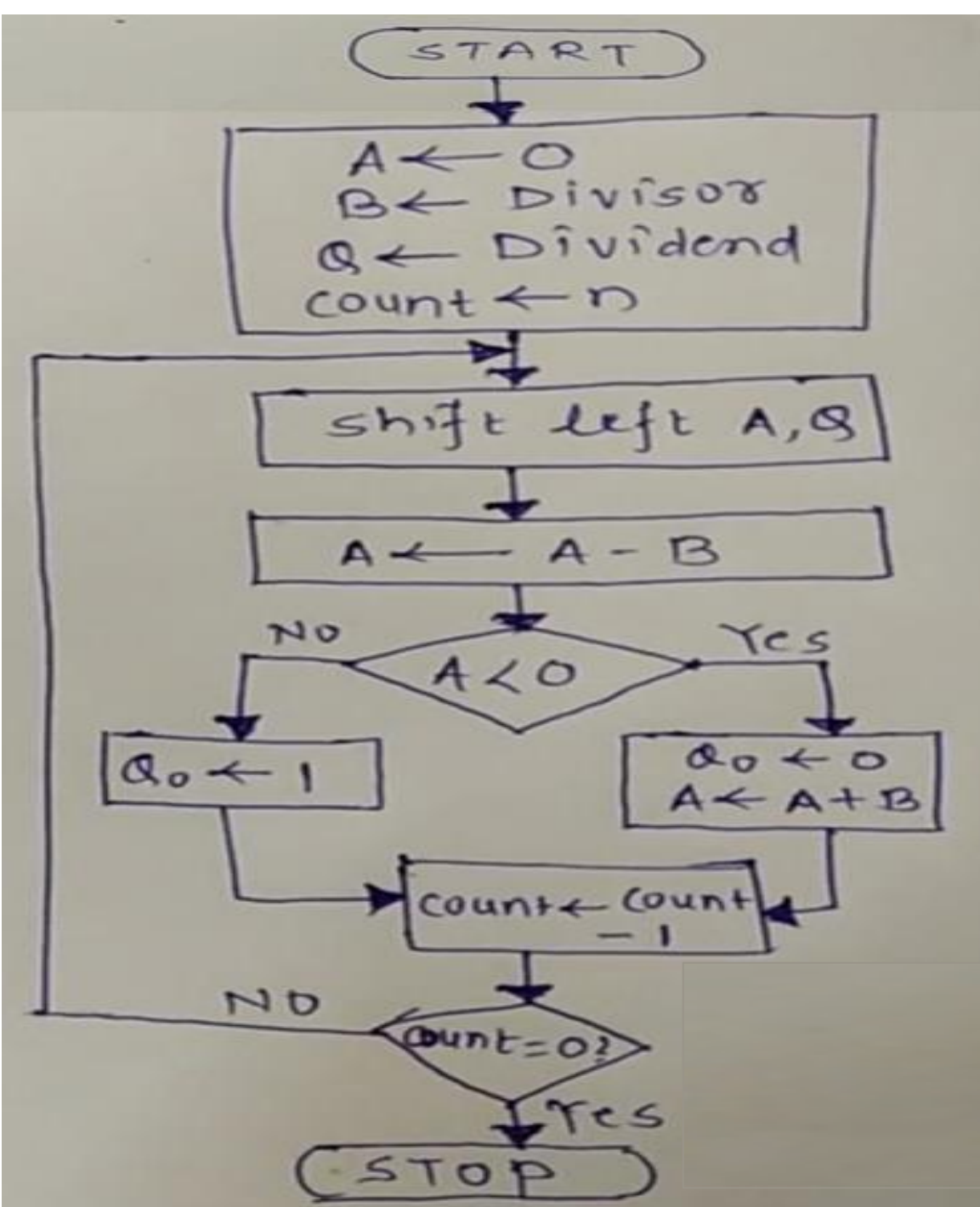
$$\begin{array}{r} 5 \\ 3 \overline{) 15} \end{array}$$

Binary

	Quotient	
Divisor	101	
	11	Dividend
	<u>11</u>	
	0011	
	<u>11</u>	
	00	
		Remainder



Arithmetic Division (Restoring Method)



Example: Dividend = 1010 $n=4$
 Divisor = 0011 $\Rightarrow B \Rightarrow 00011$
 $\bar{B}+1 = 11101$

operation A Q
 Initially 00000 1010

Example: Dividend = 1010 $n=4$
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operation A Q

Initially 00000 1010

shift + 00001 ✓ 010 ☐

subtract + 11101 } 1st cycle

set Q₀ + 00011 010 ☐ 0

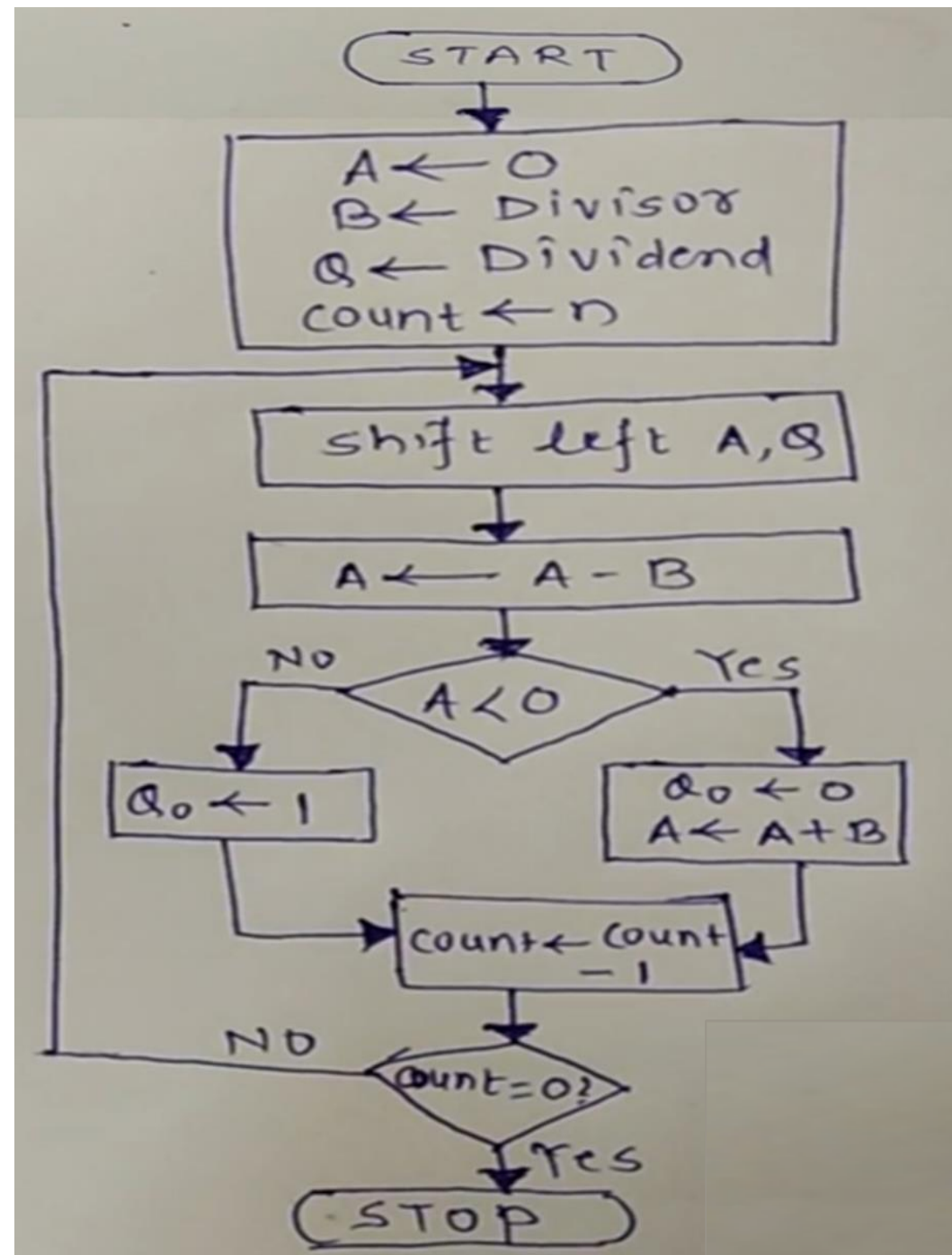
Restore A ⊗ 00001

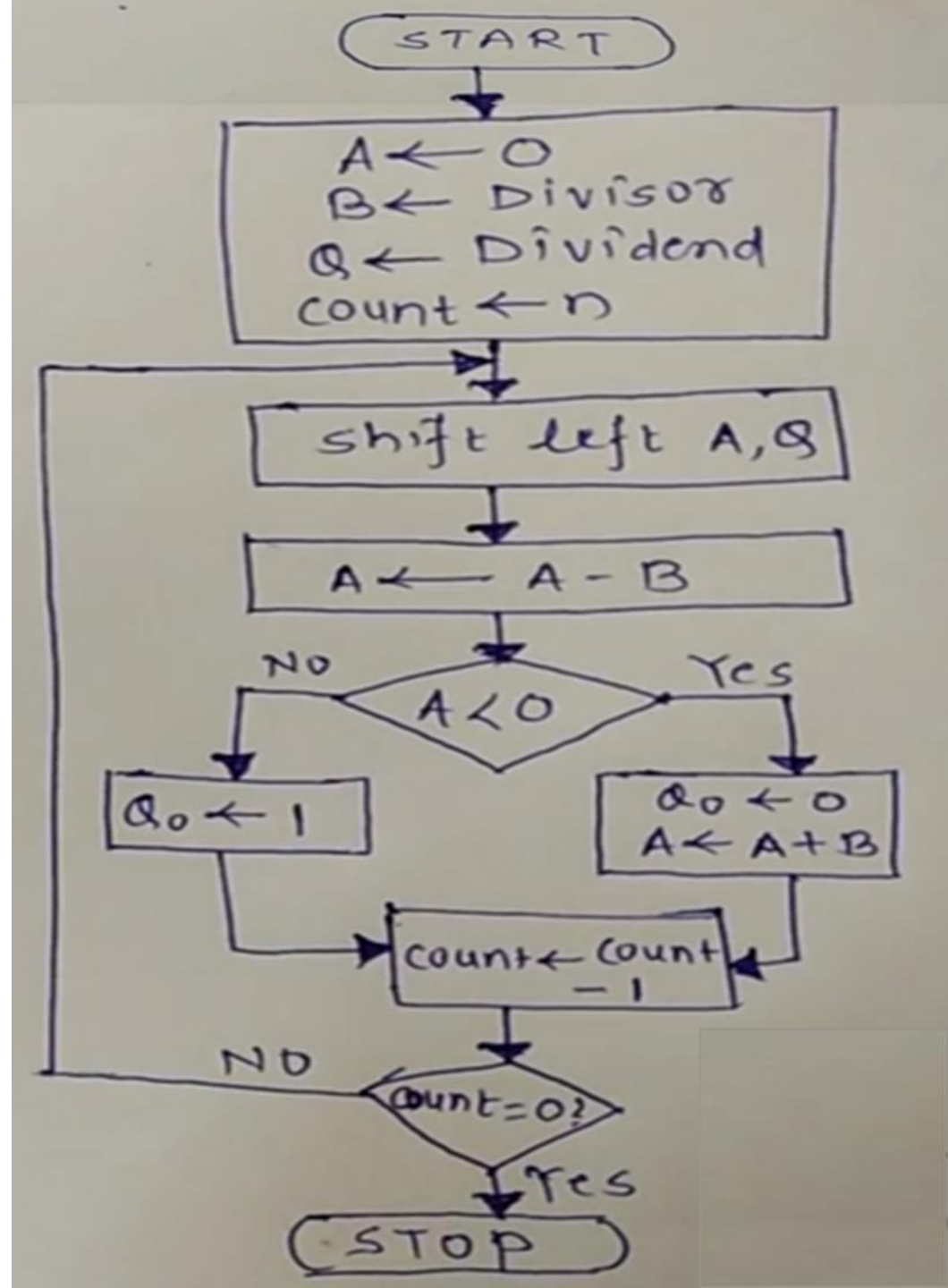
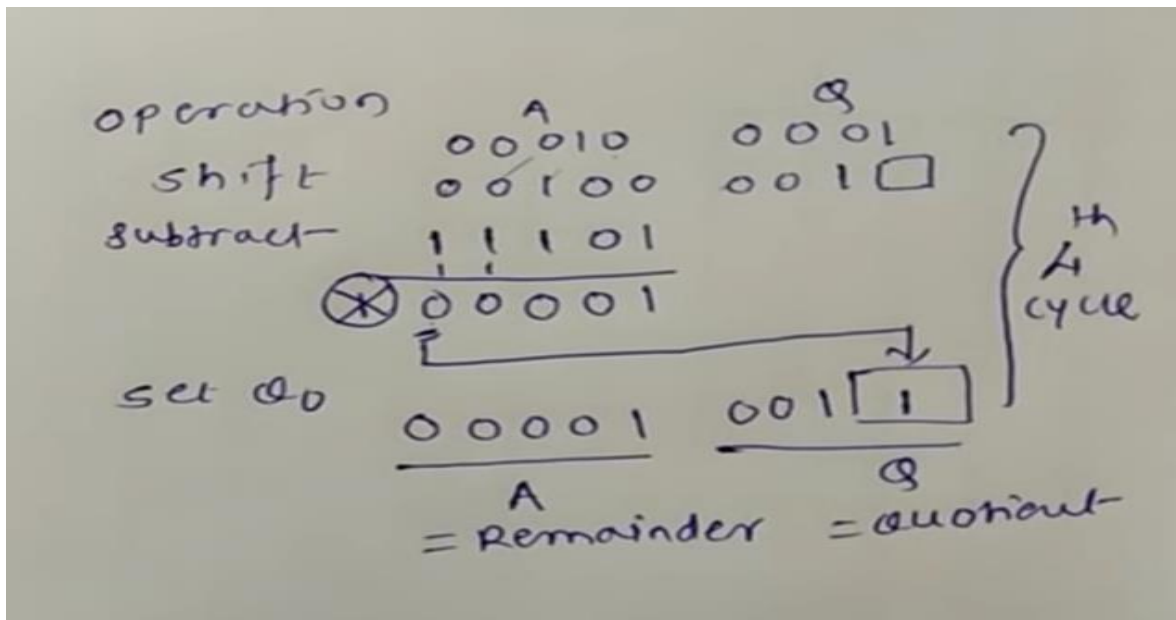
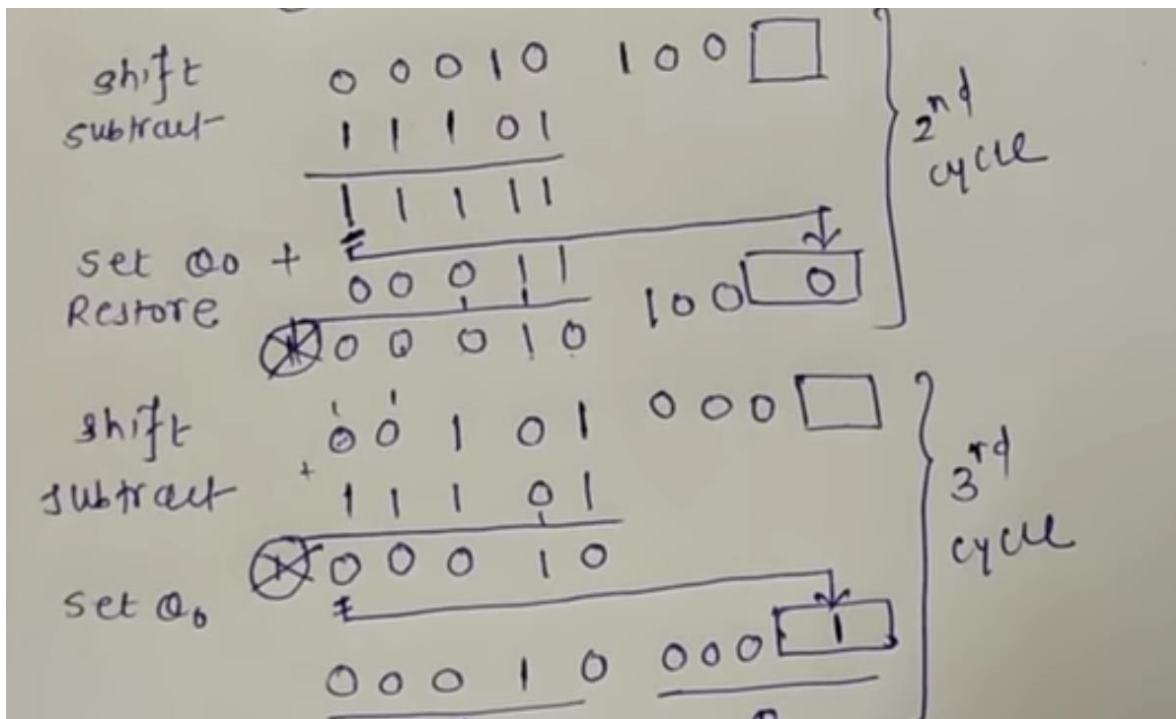
shift 00010 100 ☐

subtract + 11101 } 2nd cycle

set Q₀ + 00011 100 ☐ 0

Restore ⊗ 00010





Arithmetic Division (Non-Restoring Method)

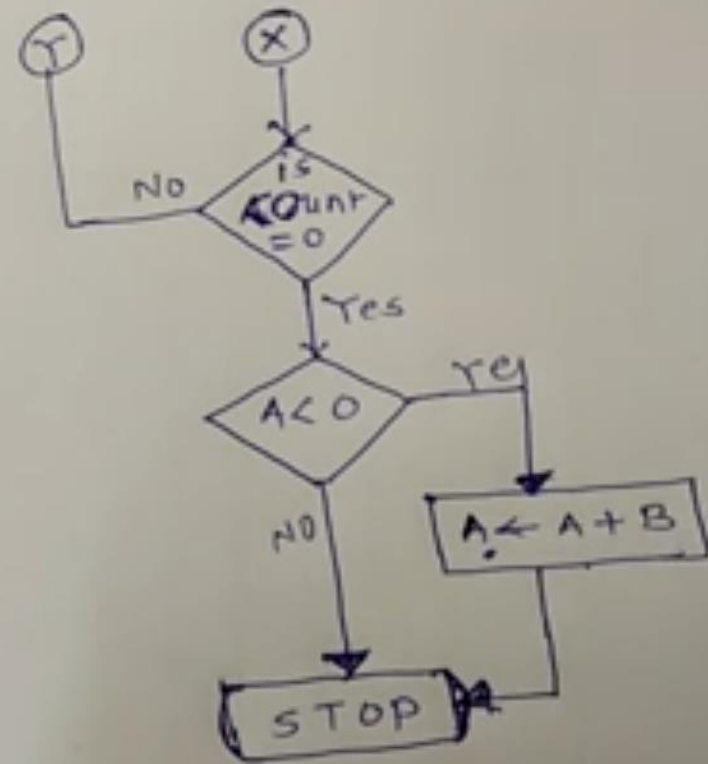
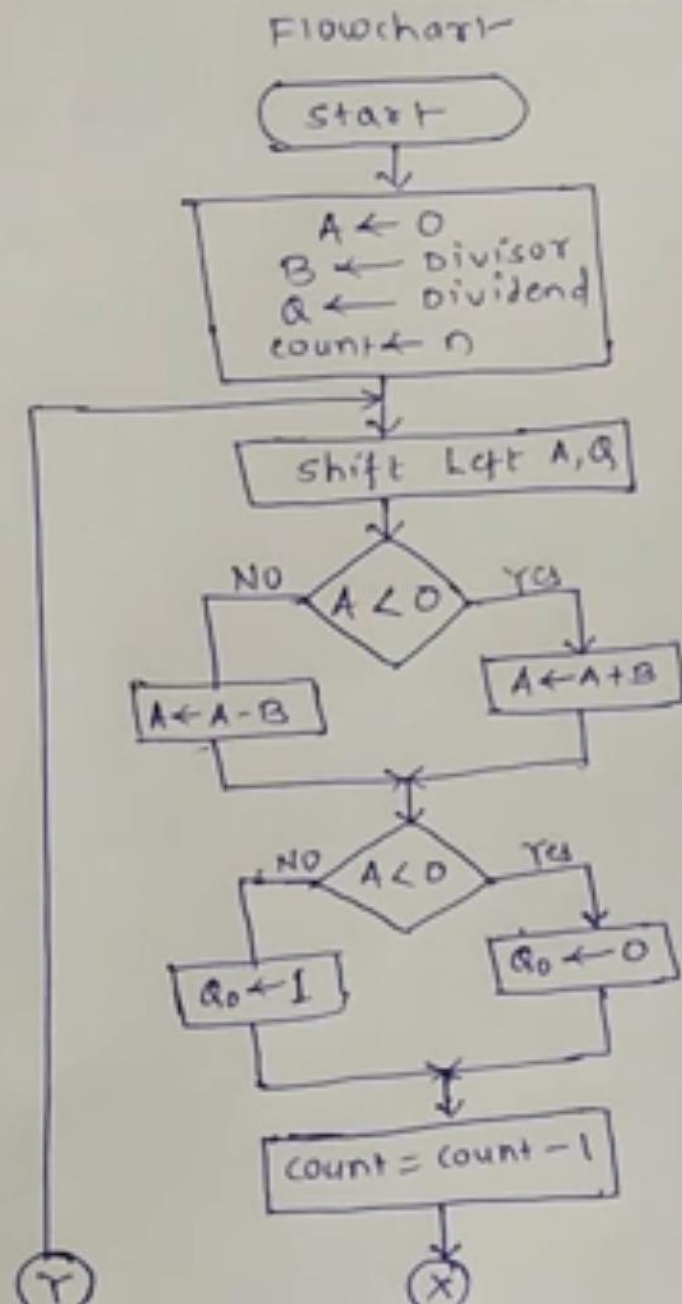


Fig:- Flowchart- for non-restoring division operation

Example: Non-restoring Division $n=4$

Dividend = 1011 $\Rightarrow Q$

Divisor = 0101 $\Rightarrow B = 0101 \Rightarrow \bar{B}+1 = 1101$

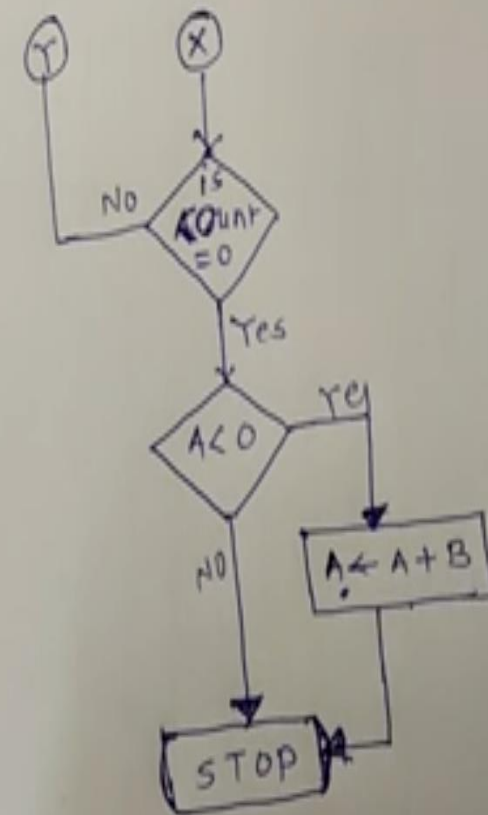
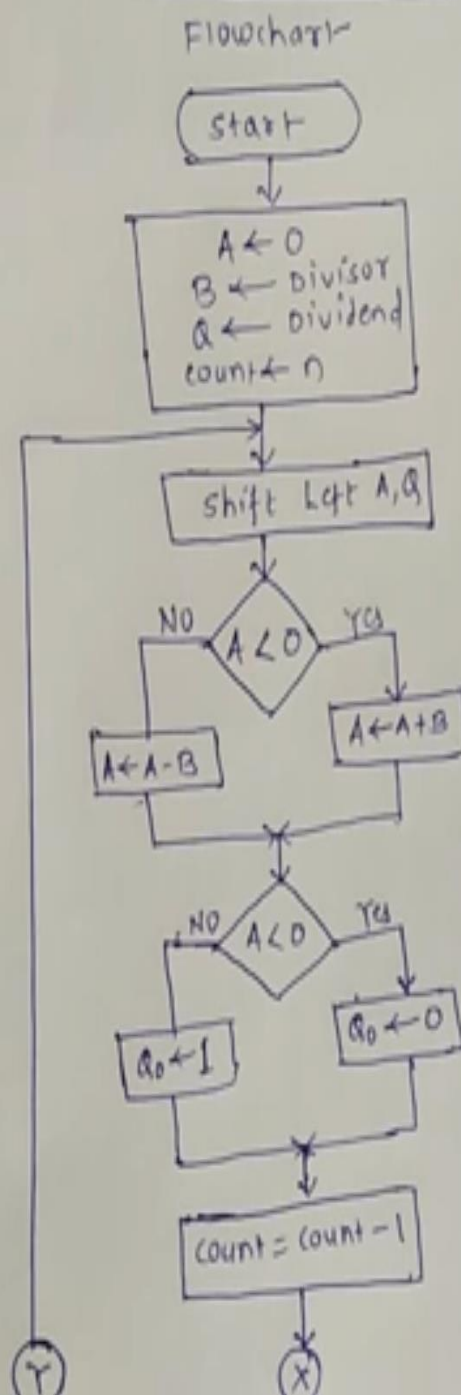
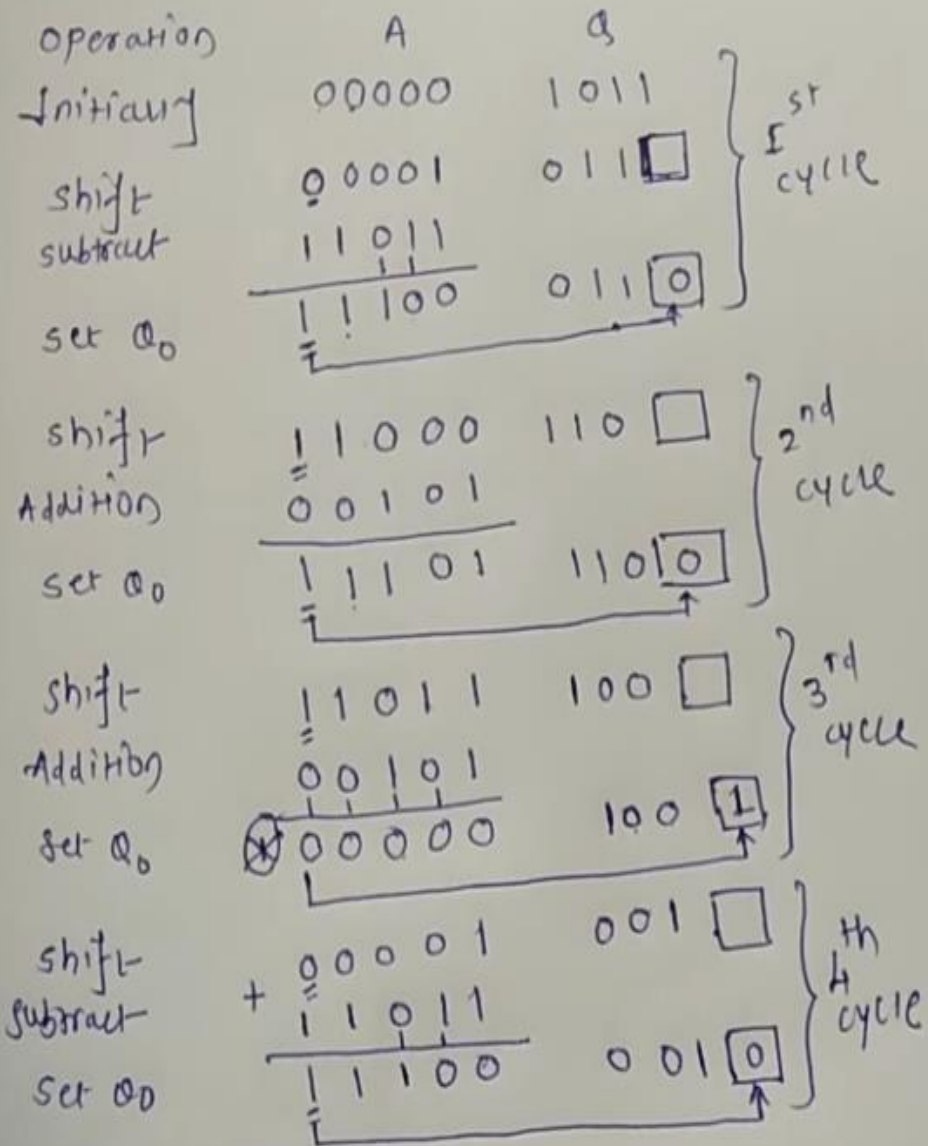
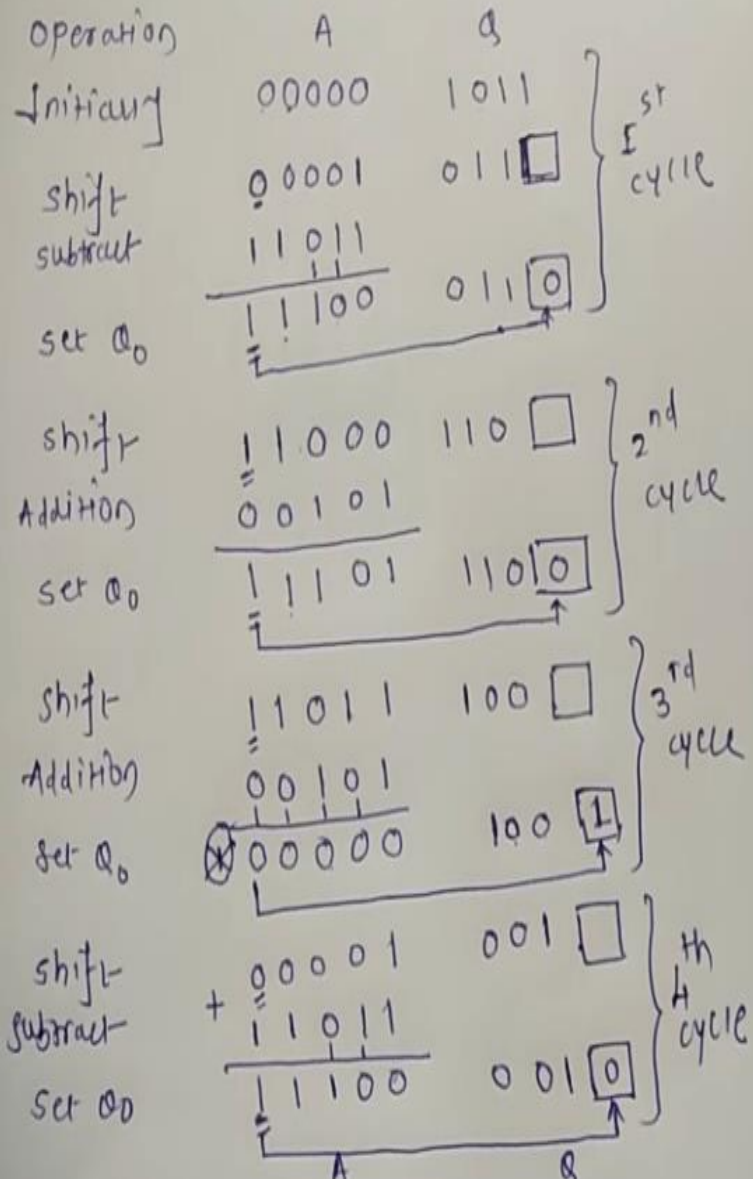


Fig:- Flowchart for non-restoring division operation

Example: Non-restoring Division $n=4$

Dividend = 1011 $\Rightarrow Q$

Divisor = 0101 $\Rightarrow B = 0101 \Rightarrow \bar{B} = 1101$



op. A Q
 Adding 11100 0010
 00101 = Q
 A = Remainder

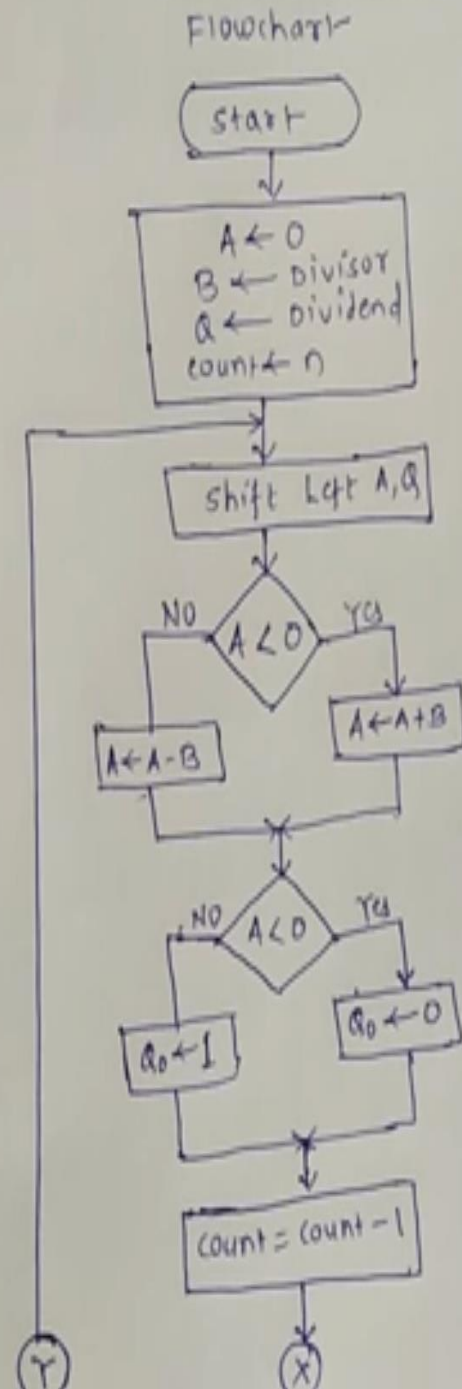
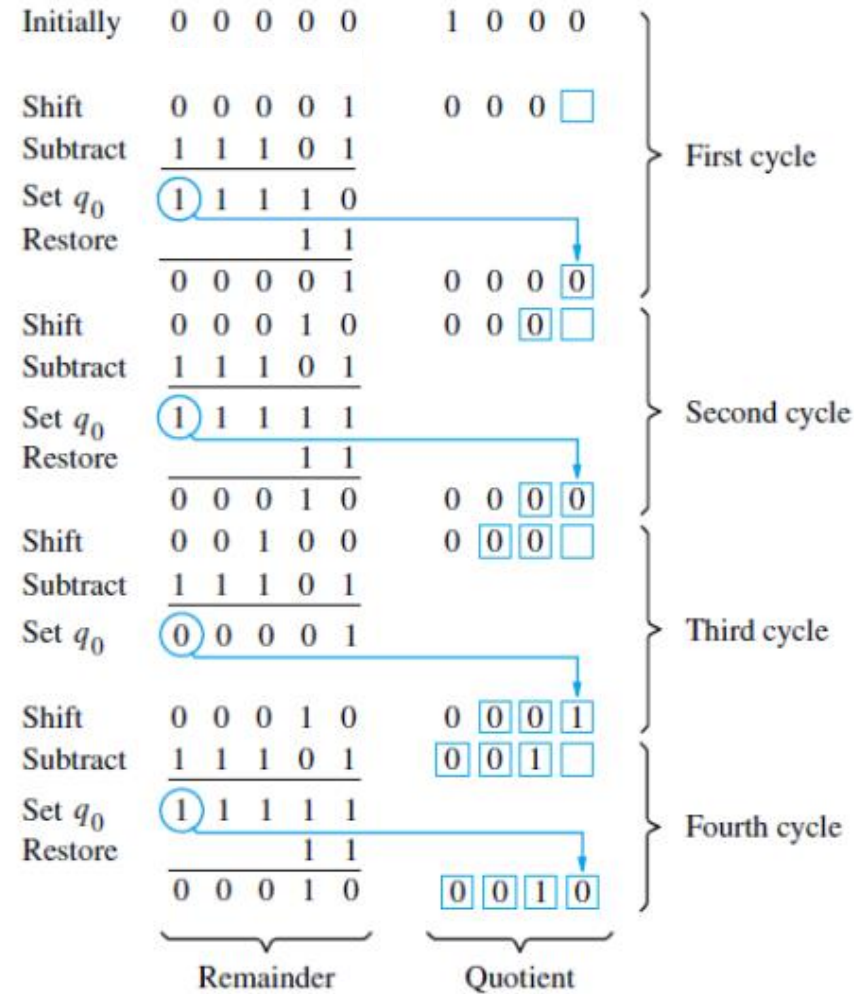


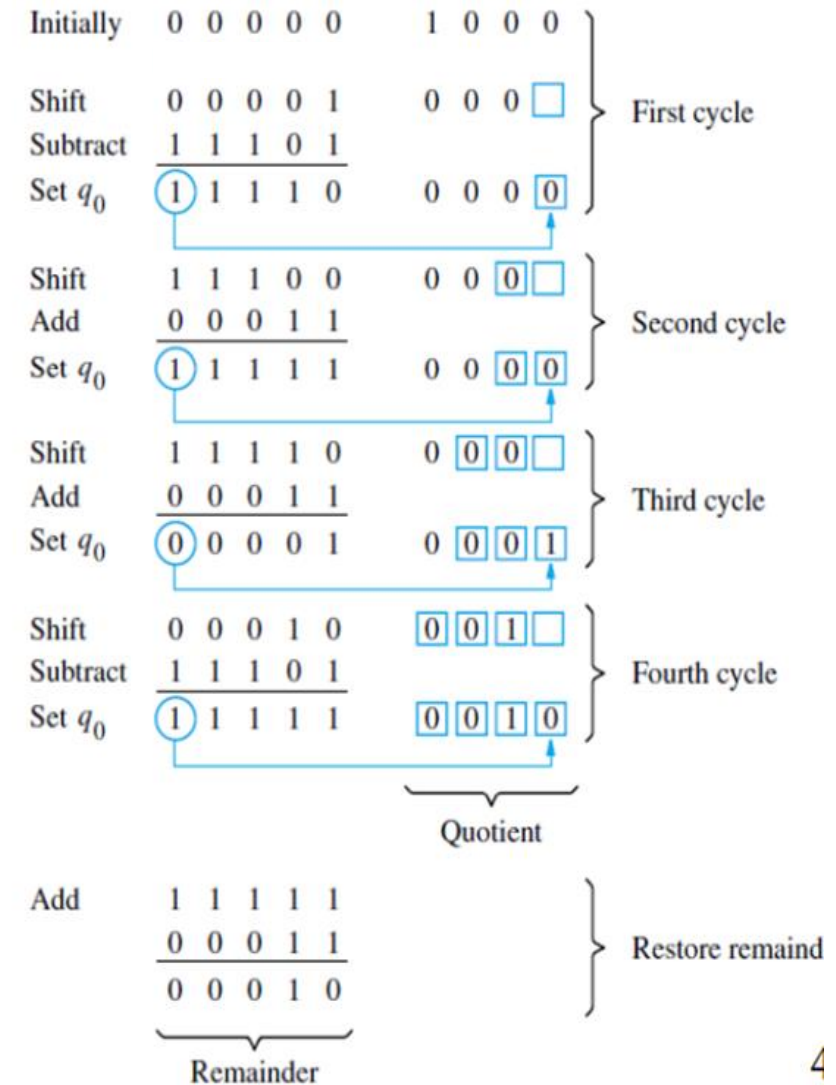
Fig:- Flowchart for non-restoring division operation

Restoring Method

$$\begin{array}{r} 10 \\ 11 \overline{) 1000} \\ \underline{11} \\ 10 \end{array}$$



Non-Restoring Method



Signed Number:

Restoring :-

$$-7 \div 3$$

$$1001 \div 0011$$

$$n=4 \quad m=00011$$

$$Q=0111$$

$$m'=11101$$

A	Q	
00000	0111	1
00000	1110	
+ 11101		
11101		
+ 00011		2
00000	1110	
00001	1100	
+ 11101		
11110		3
+ 00001	1100	
00001	1000	
+ 11101		
00000		4
00000	1001	
00001	0010	
+ 11101		
11110		
+ 00011	0010	
00001		

$$R = -1$$

$$Q = -2$$

Non-Restoring :-

$$1001 \div 0011$$

$$(-7) \div (3)$$

$$Q=1001$$

$$m=00011$$

$$n=4$$

$$m'=11101$$

$$Q=0111$$

A	Q	
00000	0111	1
00000	1110	
+ 11101		
11101		
+ 00011		2
11101	1110	
11011	1100	
+ 00011		
11110		3
11110	1100	
11101	1000	
+ 00011		
00000		4
00000	1001	
00001	0010	
+ 11101		
11110		
+ 00011	0010	
11110		

$$R = 00001$$

$$Q = 0010$$

$$R = -1$$

$$Q = -2$$

$\text{Dividend} = \text{Quotient} \times \text{Divisor} + \text{Remainder}$

- To handle signed binary number division,
 - first convert both the dividend and the divisor to positive numbers to perform the division
 - and then correct the signs of the results as needed
-
- If the dividend is positive, then the remainder will be positive.
 - If the dividend is negative, then the remainder will be negative.
 - As for the quotient, it will be positive if the divisor and the dividend have the same sign.
 - Otherwise, it will be negative.