



SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

**COURSE NAME :19IT301 COMPUTER ORGANIZATION AND
ARCHITECTURE
II YEAR /III SEMESTER**

Unit 1- Arithmetic Operations

Topic 5 :Integer division



Manual Division



$$\begin{array}{r} 21 \\ 13 \overline{) 274} \\ \underline{26} \\ 14 \\ \underline{13} \\ 1 \end{array}$$

$$\begin{array}{r} 10101 \\ 1101 \overline{) 100010010} \\ \underline{1101} \\ 10000 \\ \underline{1101} \\ 1110 \\ \underline{1101} \\ 1 \end{array}$$

Longhand division examples.

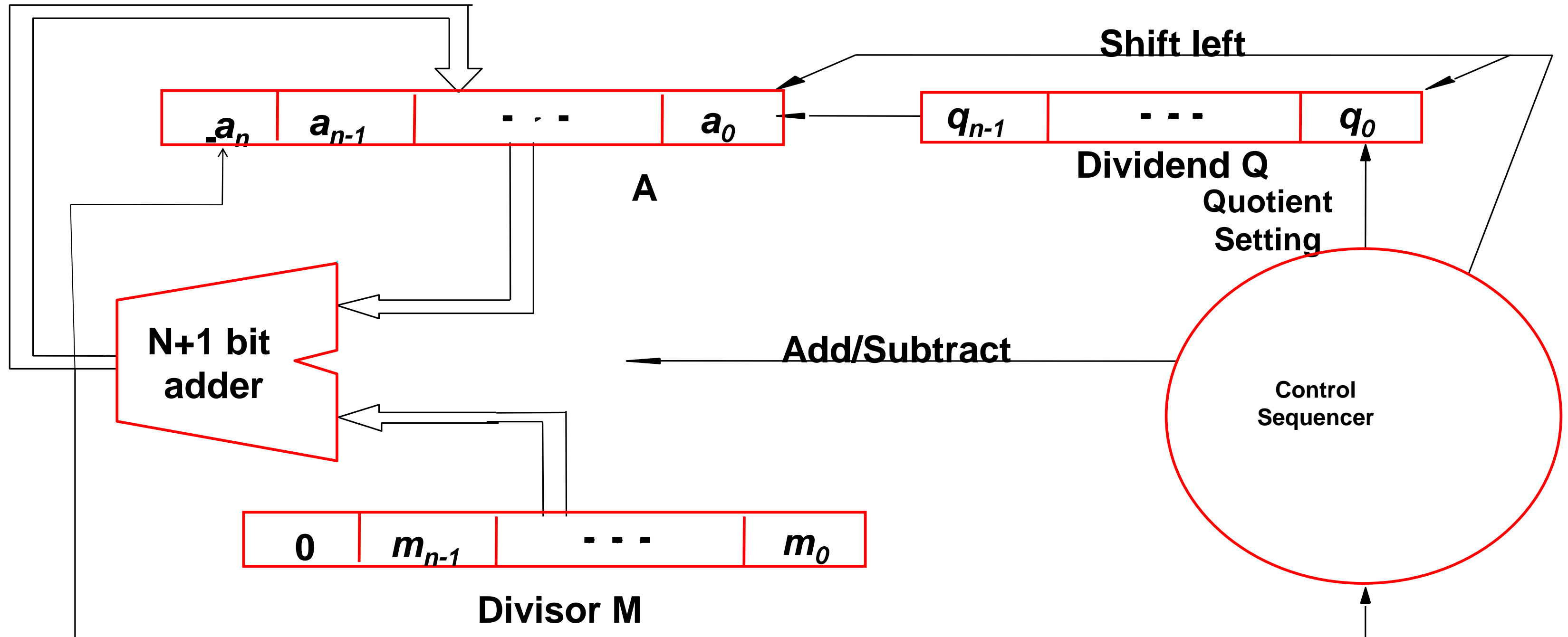


Longhand Division Steps



- ✓ Position the divisor appropriately with respect to the dividend and performs a subtraction.
- ✓ If the remainder is zero or positive, a quotient bit of 1 is determined, the remainder is extended by another bit of the dividend, the divisor is repositioned, and another subtraction is performed.
- ✓ If the remainder is negative, a quotient bit of 0 is determined, the dividend is restored by adding back the divisor, and the divisor is repositioned for another subtraction.

Circuit Arrangement





Restoring Division



Shift A and Q left one binary position

Subtract M from A, and place the answer back in A

If the sign of A is 1, set q_0 to 0 and add M back to A (restore A);
otherwise, set q_0 to 1

Repeat these steps n times



Examples

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

Initially	0 0 0 0 0	1 0 0 0	} First cycle
Shift	0 0 0 1 1	0 0 0 <input type="checkbox"/>	
Subtract	<u>1 1 1 0 1</u>		
Set q_0	1 1 1 1 0		
Restore	<u>1 1</u>	0 0 0 0	} Second cycle
Shift	0 0 0 1 0	0 0 0 <input type="checkbox"/>	
Subtract	<u>1 1 1 0 1</u>		
Set q_0	1 1 1 1 1		
Restore	<u>1 1</u>	0 0 0 0	} Third cycle
Shift	0 0 1 0 0	0 0 0 <input type="checkbox"/>	
Subtract	<u>1 1 1 0 1</u>	0 0 0 <input type="checkbox"/>	
Set q_0	0 0 0 0 1		
Shift	0 0 0 1 0	0 0 0 1	} Fourth cycle
Subtract	<u>1 1 1 0 1</u>	0 0 1 <input type="checkbox"/>	
Set q_0	1 1 1 1 1		
Restore	<u>1 1</u>	0 0 1 0	
	<u>0 0 0 1 0</u>		
	Remainder	Quotient	



Nonrestoring Division



Avoid the need for restoring A after an unsuccessful subtraction.

Any idea?

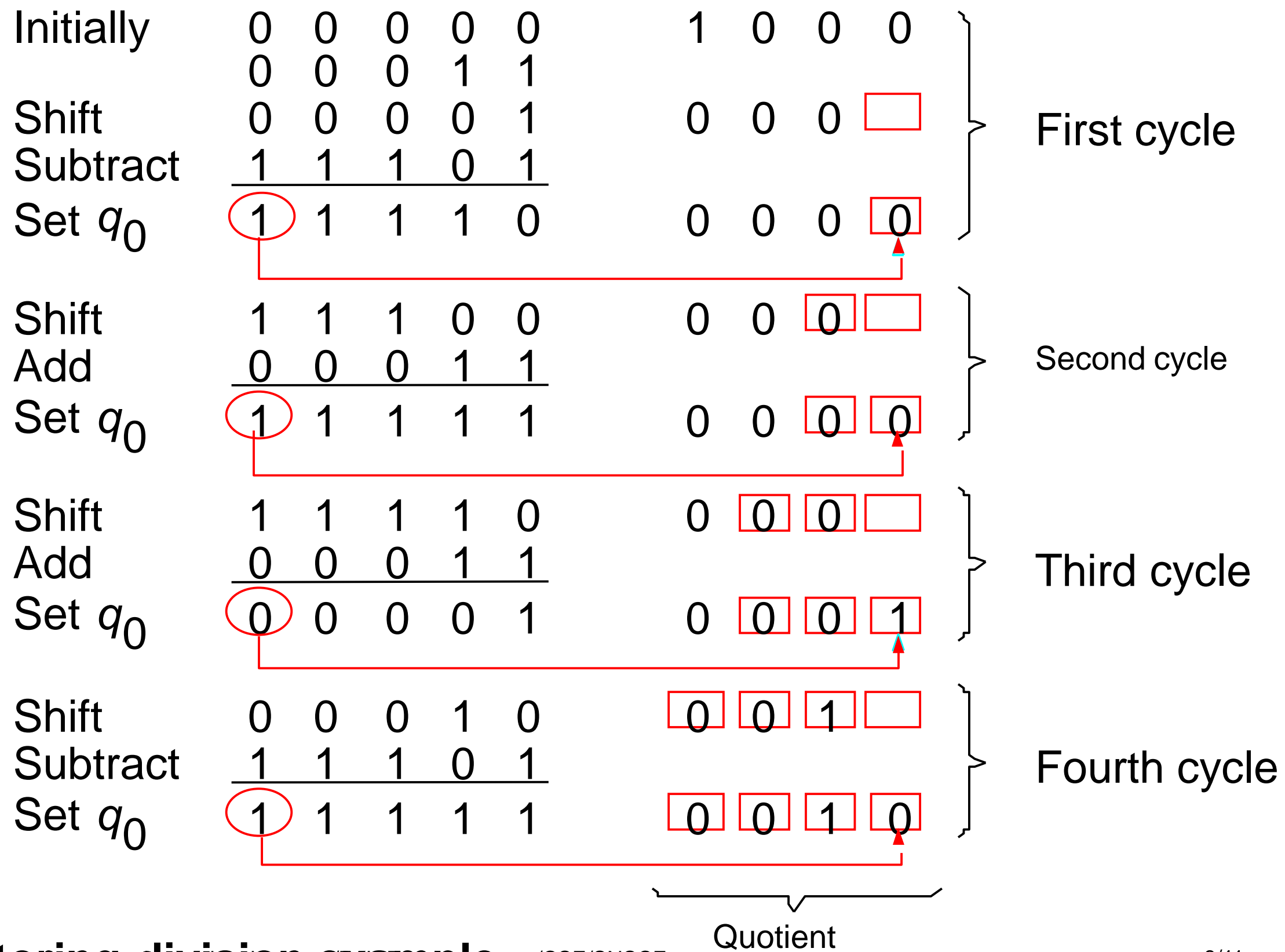
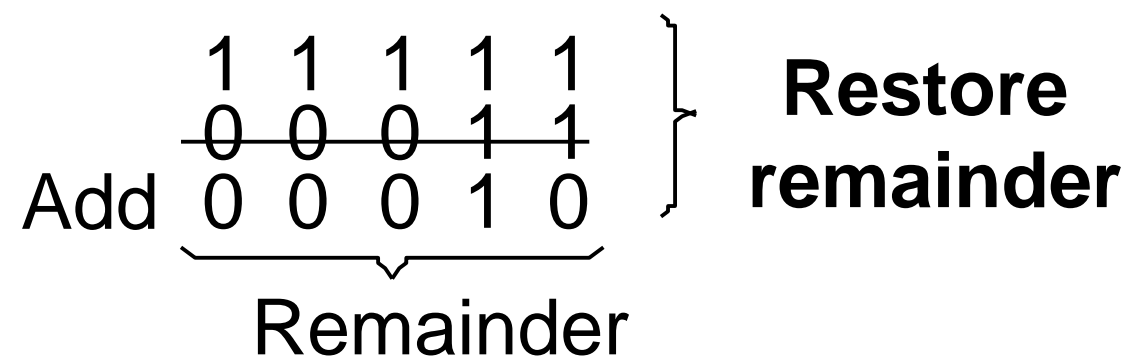
Step 1: (Repeat n times)

- If the sign of A is 0, shift A and Q left one bit position and subtract M from A; otherwise, shift A and Q left and add M to A.
- Now, if the sign of A is 0, set q_0 to 1; otherwise, set q_0 to 0.

Step2: If the sign of A is 1, add M to A



Examples



Quotient



Assessment



- a). What is restoring division?
- b). What is non restoring division?
- c) Compare restoring division and non restoring division





Reference



1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization”, McGraw-Hill, 6th Edition 2012.