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# Experiment No 05

→ Aim - To perform Booth's Algorithm

→ Theory: • Booth's Multiplication Algorithm is widely used for multiplication of two signed binary numbers.

• It is popular due to its speed and efficiency

→ Procedure:

Step 1 : Initialize the registers i.e. Place the multiplier and multiplicand in Q and M register respectively. Also AC and Q$_1$ and ~~M registers respectively~~ are initialized to zero. The count (n) value is initialized to the maximum of the two values, either the no. of bits required to store the binary representation of the 2's complement of the Multiplicand or the no. of bits required to store the binary representation of the multiplier.

Step 2: The control logic scans the bit of the multiplier. Each bit of the multiplier is examined with bit to its right.

Step 2.1 :- If the two bits are same (ie. 0-0 or 1-1) then all the bits are shifted to right of register AC, Q and $Q_{-1}$ [Arithmetic shift]. The shifting process is such that the left most bit of AC is retained and also shifted to next position. This type of shifting is called as Arithmatic shifting.

Step 2.2 - If the two bits are of the form [01 or 10] the the Multiplicand is subtracted from AC or added to AC. After subtracted or added, the bits of AC, Q, $Q_{-1}$ are shifted right by 1 bit.

Step 3.0 : Decrement count value and check if count equals zero.

Step 3.1 : If count ≠0, Repeat step 2.

→ Example - Q.] Perform $(-8)_{10} \times (2)_{10}$ by Booth's Algorithm.

Ans $(-8)_{10} = (11000)_2 = M$ $(2)_{10} = (00010)_2 = Q$

$(8)_{10} = (01000) = -M$

$A = 00000$ ; $Q_{-1} = 0$ ; $n = 5$

→ Flowchart of Booth's Algorithm :

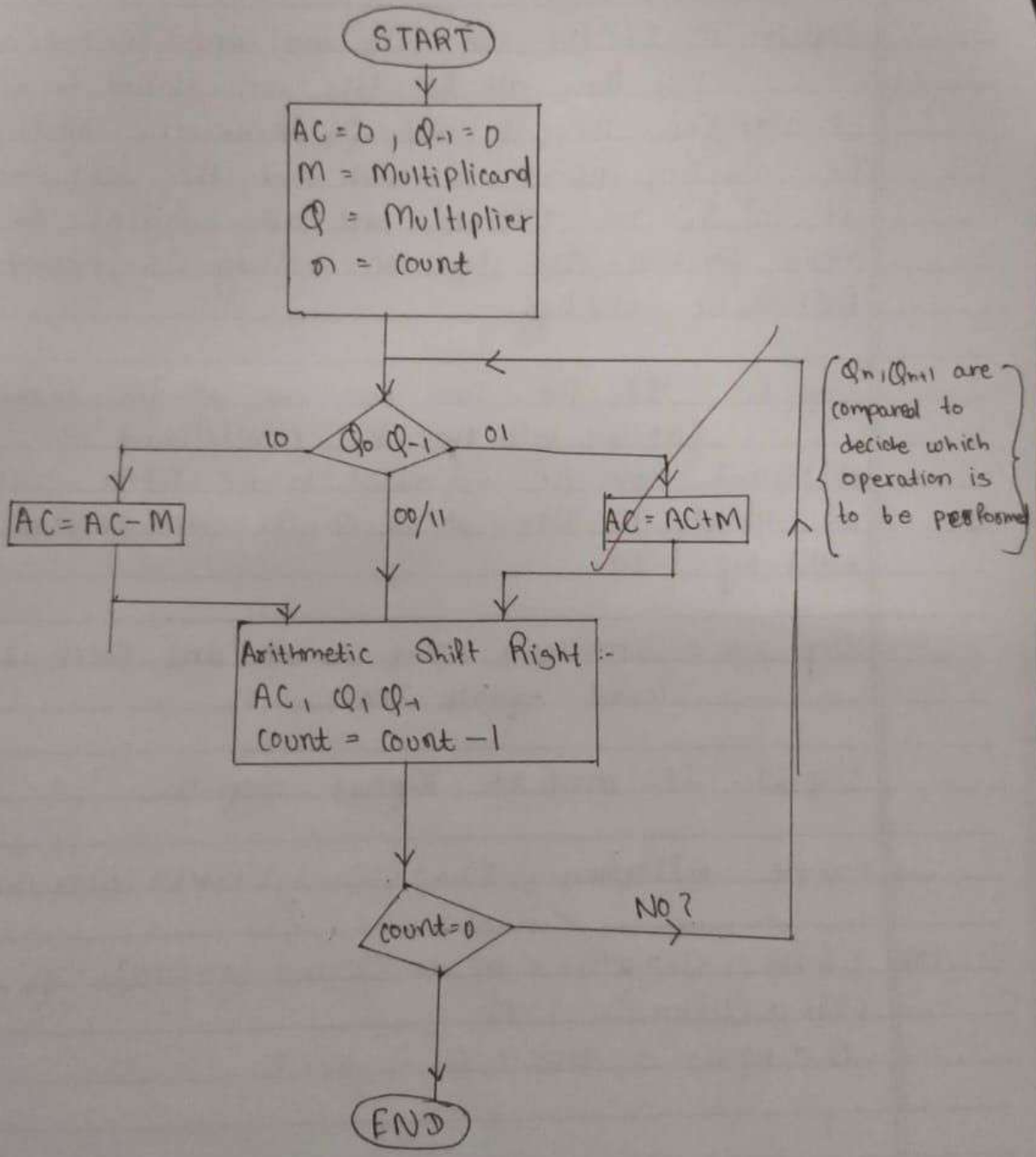


Fig-Booth's Algorithm Flowchart

| $Q_0Q_{-1}$ | Action | A | Q | $Q_{-1}$ | n |
|---|---|---|---|---|---|
| 00 | Initialization | 00000 | 00010 | 0 | 5 |
| 00 | ASR - A, Q, $Q_{-1}$ | 00000 | 00001 | 0 | 4 |
| 10 | A = A - M | | | | |
| | = 00000 | 01000 | 00001 | 0 | 4 |
| | + 01000 | | | | |
| | A = 01000 | | | | |
| | ASR → A, Q, $Q_{-1}$ | 00100 | 00000 | 1 | 3 |
| 01 | A = A + M | | | | |
| | = 00100 | 11100 | 00000 | 1 | 323 |
| | + 11000 | | | | |
| | A = 11100 | 11110 | 00000 | 0 | 2 |
| | ASR → A, Q, $Q_{-1}$ | | | | |
| 00 | ASR → A, Q, $Q_{-1}$ | 11111 | 00000 | 0 | 1 |
| 00 | ASR → A, Q, $Q_{-1}$ | 11111 | 10000 | 0 | 0 |

n = 0 ⇒ Answer = $(1111110000)_2 = (-16)_{10}$

The answer above is in 2's complement form

16 = 0000010000 $\xrightarrow{1\text{'s comp.}}$ 1111101111 $\xrightarrow{2\text{'s comp.}}$ $(1111110000)_2$

→ Conclusion : Thus the Booth's Algorithm is verified.