

Lecture - 4

Division

$$3 \overline{) 10} \begin{array}{l} 3 \\ 9 \\ \hline 1 \end{array}$$

Quotient (Q)

Remainder (R)

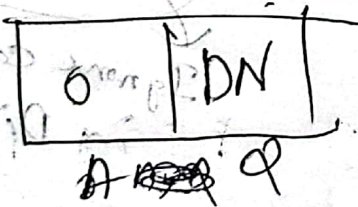
Division normally

2 Registers

Optimised division
2 Registers

1010 → Dividend (DN)
0011 → Divisor (DR)

(A, Q) → Register



DN 20 bit

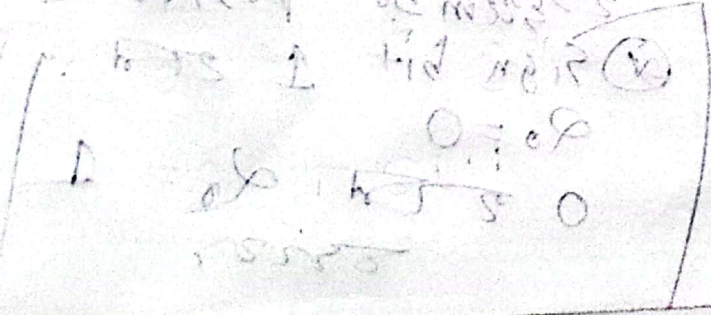
Step:

DN 20 bit
A 20 bit

M = Divisor (DR)

Function: (A, Q) Register, M → Register

$$1100 + 0111 = 10001$$



Initial:

2's complement
1's complement

A, Q: 0000 1010

0011

M: 0011

~~M~~
-M: 1101

(b) 1100

+1

1101

2's complement

Step 1

① A, Q: 0001 0100

A = A - M
= A + (-M)

= 0001 + 1101

= 1110

Ignore carry in Division

② = 1110 0100

Negative

③ A = A + M
= 1110 + 0011

= 1000

Ignore carry

1110

sign bit

1 2's A

negative

0 2's A

positive

Sign bit

Q₀ = 0

0 2's A Q₀ = 1

Step 2

A, Q: 0201, 0100

① A, Q: 0010 1000 ?

② A, Q: 1111 1000 ?

opposite

③ A, Q: 0010 1000

Step 3:

A, Q: 0101 000 ?

A, Q: 0010 000 ?

According to Algo

Step 4:

A, Q: 0100 001 ?

A, Q: 0001 001 ?

A

Q

Answer

Answer

Step 5

011 0100 : A

011 1101 : A

001 0100 : A

4

④

1011 = DN

0111 = DR

m: 0111

~~0000~~ 1000 : P, A

+1

-m: 1001

0001 0100 : P, A

In: ~~0000 1011~~

A, Q: 0000 1011

m: 0111

-m: 1001

0001 1111 : P, A
0001 1001 : P, A
0001 1010 : P, A

0001 0100 : P, A

Step 1:

A, Q: 1000 1011 : P, A

A, Q: 1010 0110 : P, A

A, Q: 0001 0110 : P, A

0000 1010 : P, A
0000 1011 : P, A
0000 0100 : P, A

Step 2:

A, Q: 0010 1100 : P, A

A, Q: 1011 1100 : P, A

A, Q: 0010 1100 : P, A

1100 1000 : P, A
1100 1000 : P, A
1100 1000 : P, A

Step 3:

A, Q: 0101 100?

AA: 1110 1000

A, Q: 0101 1000

$$\begin{array}{r} 0101 \\ 1001 \\ \hline 1110 \end{array}$$

$$\begin{array}{r} 1011 \\ 1001 \\ \hline \textcircled{X} 0100 \end{array}$$

Step 4:

A, Q: 1011 000?

$$\begin{array}{r} 0100 \\ \hline A \end{array} \quad \begin{array}{r} 0001 \\ \hline Q \end{array}$$