## Paper 7, TDC Part-3

Chapter- 3, Number Systems and Codes Electronics
Lecture - Subtraction, Multiplication and Division

## By:

Mayank Mausam
Assistant Professor (Guest Faculty)
Department of Electronics
L.S. College, BRA Bihar University,

Muzaffarpur, Bihar

## Number Systems and Codes

## Binary Subtraction: -

The four basic rules for subtracting $0 \& 1$ are: -
$0-0=0$----- Difference part is 0 and borrow part is
0.

0-1 = 1 ----- Difference part is 1 and borrow part is 1.

1-0 = 1 ----- Difference part is 1 and borrow part is 0.

1-1 = 0 ----- Difference part is 0 and borrow part is 0.

## Number Systems and Codes

Borrow is required when Minuend bit is less than the Subtrahend.
In binary system a borrow of 1 from higher bit position is equivalent to increment of $10_{2}$ that is $2_{10}$ to lower bit.

Let's see few examples.
Examples- Subtract the following binary numbers -
a) 11001 and 1000
b) 11100 and 11010
c) 11100011 and 10110101

Number Systems and Codes
Solunfim $\rightarrow$ (a)

$$
\begin{array}{r}
110001 \\
-10000 \\
\hline(000011)_{2}^{1}
\end{array}
$$

Borrow is required
(b)

$$
=\frac{111100}{101010}
$$

(C)

$$
\left.\begin{array}{llllllll}
1 & 1 & 1 & 1 & 0 & 1 & 10 & 1
\end{array}\right]
$$

When a $1^{\text {is }}$, borrowed from, the higher but posinim then the lower bit is increment by '2' i.e. '10', and again, when 1 is borrowed from this is an then this becomes 1 and the lower bitt becomes "10", and, sa on_ in the same bikaner. Barrow propagates to lower but from higher bit.

## Number Systems and Codes

## Binary Multiplication: -

The four basic rules for multiplying $0 \& 1$ in binary system is: -
$0 \times 0=0$
$0 \times 1=0$
$1 \times 0=0$
$1 \times 1=1$
Multiplication in binary system is performed like decimal system. It involves forming partial products. Shifting each partial product left one place, and then adding all the partial products.

Number Systems and Codes
Example:- Texporm the following binary numbers (a) $1101 \times x \quad 1100$

$$
\text { (b) } 1100 \times 101
$$



$$
\left(\begin{array}{cccccc}
1 & 1 & 1 & 0 & 1 \\
1 & 1 & 0 & 1 & 1 & 1
\end{array} 1 \begin{array}{llll}
1 & 1 & 0
\end{array}\right) \quad \Rightarrow(78)_{10}
$$

(b)

$$
\begin{aligned}
& \left.\begin{array}{lll}
1 & 1 & 0 \\
x_{1} & \longrightarrow & \left(\begin{array}{ll}
1 & 2
\end{array}\right) 10 \\
0 & 5
\end{array}\right)=100 \\
& 1 \begin{array}{llll}
1 & 1 & 0 & 0
\end{array} \\
& \begin{array}{llll}
0 & 0 & 0 & 0 \\
1 & 1 & 0 & 0 \\
1 & 1 & 1 & 0
\end{array} \\
& \left(\begin{array}{ll}
6 & 0
\end{array}\right)_{10} \\
& \begin{array}{lll}
100 \\
x 11 \\
100 & & \longrightarrow \\
100 & & (4) 10 \\
1100 & & \\
100 & (12)_{10}
\end{array} \\
& \longrightarrow(4) 10
\end{aligned}
$$

(C)

## Number Systems and Codes

## Binary Division: -

Division in binary system is performed by the same procedure as in decimal system.

Some examples to illustrate division in binary number system

Number Systems and Codes
Example $\rightarrow$ Divide (a) $(1110111)$, by $\left(\begin{array}{llll}1 & 0 & 1\end{array}\right)_{2}$
(b) $\left(\begin{array}{lllllll}1 & 0 & 0 & 1 & 0 & 0\end{array}\right)_{2}$ by $(111000) 2$

Solution:- (a)

$$
\begin{aligned}
& \leftarrow \text { Quotient } \\
& \text { Dividend. }
\end{aligned}
$$

Sw when we divide $(27)_{10}=(1 \pm 011)_{2}$
 quotient of $\left(\frac{2}{5}\right)_{10}=(101)_{2}$ and remainder of $(2)_{10}=(10)_{2}$
(b)

$$
\begin{aligned}
& 1100 \text { ) } 10101 \leftarrow \text { Quotient } \\
& \begin{array}{llll}
1 & 1 & 0 & 0 \\
1 & 1 & 1 & 1
\end{array} 0 \\
& \begin{array}{lll}
\frac{1}{1} 1 & 1 \\
x \times 1 & 0 & 0
\end{array}
\end{aligned}
$$

REDMI NÖTESSTRRONe divide $(76) 10=(1001100)_{2}$

## Number Systems and Codes

When we divide $(76)_{10}=(1001100)_{2}$ by $(12)_{10}=(1100)_{2}$ we find quotient as $(6)_{10}=(110)_{2}$ and remainder as $(4)_{10}=(100)_{2}$

## Thank You

