VINAYAKAR MATRICULATION HIGHER SECONDARY SCHOOL, SIVAKASI.

Std:11 **Subject: COMPUTER APPLICATIONS**

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Warm Greetings!

Dear Students,

In this note, we are going to discuss about Binary Arithmetic.

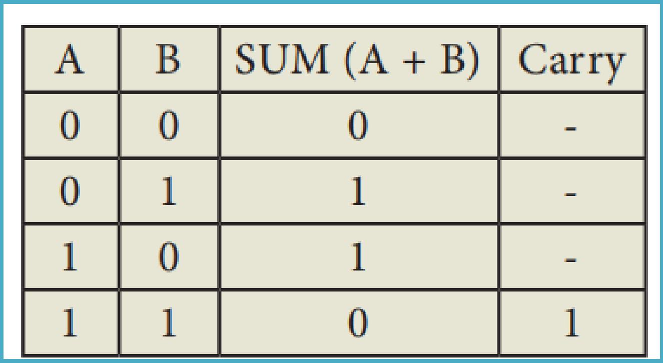
Chapter 1: Number System Conversions

Binary Arithmetic

As decimal numbers, the binary numbers also permit computations like addition, subtraction, multiplication and division. The following session deals only with binary addition and subtraction.

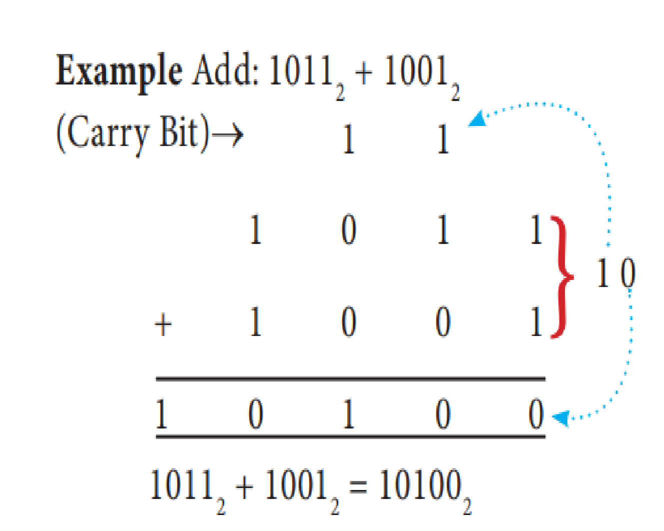
Binary Addition

The following table is useful when adding two binary numbers.



A	B	SUM (A + B)	Carry
0	0	0	-
0	1	1	-
1	0	1	-
1	1	0	1

In 1 + 1 = 10, is considered as sum 0 and the 1 as carry bit. This carry bit is added with the previous position of the bit pattern.



Example Add: $1011_2 + 1001_2$

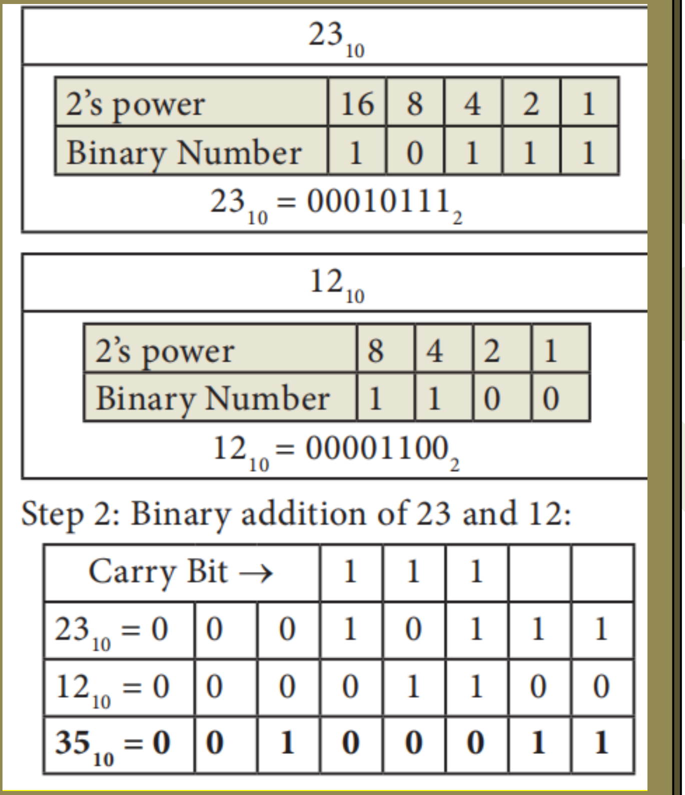
$$\begin{array}{rccccc} \text{(Carry Bit)}\rightarrow & & & 1 & 1 & \\ & & 1 & 0 & 1 & 1 \\ + & & 1 & 0 & 0 & 1 \\ \hline & 1 & 0 & 1 & 0 & 0 \end{array}$$

$1011_2 + 1001_2 = 10100_2$

Example

Perform Binary addition for the following: 23_{10} + 12_{10}

Step 1: Convert 23 and 12 into binary form



23_{10}

2's power	16	8	4	2	1
Binary Number	1	0	1	1	1

$23_{10} = 00010111_2$

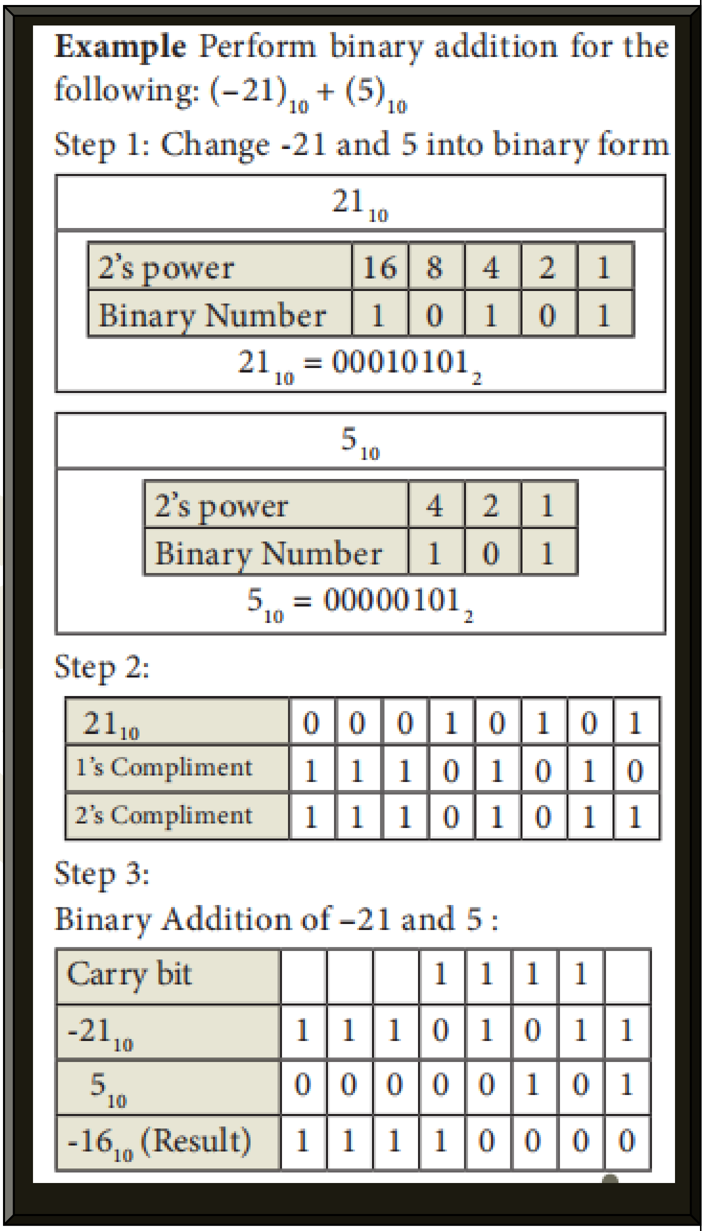
12_{10}

2's power	8	4	2	1
Binary Number	1	1	0	0

$12_{10} = 00001100_2$

Step 2: Binary addition of 23 and 12:

Carry Bit →			1	1	1		
$23_{10} = 0$	0	0	1	0	1	1	1
$12_{10} = 0$	0	0	0	1	1	0	0
$35_{10} = 0$	**0**	**1**	**0**	**0**	**0**	**1**	**1**



Example Perform binary addition for the following: $(-21)_{10} + (5)_{10}$

Step 1: Change -21 and 5 into binary form

21_{10}

2's power	16	8	4	2	1
Binary Number	1	0	1	0	1

$21_{10} = 00010101_2$

5_{10}

2's power	4	2	1
Binary Number	1	0	1

$5_{10} = 00000101_2$

Step 2:

21_{10}	0	0	0	1	0	1	0	1
1's Compliment	1	1	1	0	1	0	1	0
2's Compliment	1	1	1	0	1	0	1	1

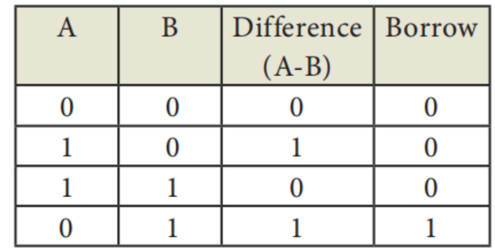
Step 3:

Binary Addition of −21 and 5 :

Carry bit				1	1	1	1	
-21_{10}	1	1	1	0	1	0	1	1
5_{10}	0	0	0	0	0	1	0	1
-16_{10} (Result)	1	1	1	1	0	0	0	0

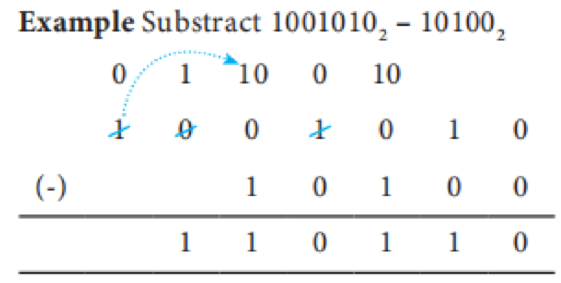
Binary Subtraction

The table for Binary Subtraction is as follows:



A	B	Difference (A-B)	Borrow
0	0	0	0
1	0	1	0
1	1	0	0
0	1	1	1

When subtracting 1 from 0, borrow 1 from the next Most Significant Bit, when borrowing from the next Most Significant Bit, if it is 1, replace it with 0. If the next Most Significant Bit is 0, you must borrow from a more significant bit that contains 1 and replace it with 0 and 0s up to that point become 1s.



Example Substract $1001010_2 - 10100_2$

$$\begin{array}{lccccccc} & 0 & 1 & 10 & 0 & 10 & & \\ & \cancel{1} & \cancel{0} & 0 & \cancel{1} & 0 & 1 & 0 \\ (-) & & & 1 & 0 & 1 & 0 & 0 \\ \hline & & 1 & 1 & 0 & 1 & 1 & 0 \\ \hline \end{array}$$

Representing Characters in Memory

- As represented in introduction, all the input data given to the computer should be in understandable format.
- In general, 26 uppercase letters, 26 lowercase letters, 0 to 9 digits and special characters are used in a computer, which is called character set.
- All these character set are denoted through numbers only. All Characters in the character set needs a common encoding system.
- There are several encoding systems used for computer.

They are

- BCD – Binary Coded Decimal
- EBCDIC – Extended Binary Coded Decimal Interchange Code
- ASCII – American Standard Code for Information Interchange
- Unicode
- ISCII - Indian Standard Code for Information Interchange

Binary Coded Decimal (BCD)

- This encoding system is not in the practice right now.
- This is 26 bit encoding system.
- This can handle 26 = 64 characters only.

American Standard Code for Information Interchange (ASCII)

- This is the most popular encoding system recognized by United States.
- Most of the computers use this system.
- Remember this encoding system can handle English characters only.
- This can handle 27 bit which means 128 characters.
- In this system, each character has individual number (Refer Appendix).
- The new edition (version) ASCII -8, has 28 bits and can handle 256 characters are represented from 0 to 255 unique numbers.
- The ASCII code equivalent to the uppercase letter ‘A’ is 65.
- The binary representation of ASCII (7 bit) value is 1000001.
- Also 01000001 in ASCII-8 bit.

Extended Binary Coded Decimal Interchange Code (EBCDIC)

- This is similar to ASCII Code with 8 bit representation.
- This coding system is formulated by International Business Machine(IBM).
- The coding system can handle 256 characters.
- The input code in ASCII can be converted to EBCDIC system and vice - versa.

Indian Standard Code for Information Interchange (ISCII)

- ISCII is the system of handling the character of Indian local languages.
- This is a 8-bit coding system.
- Therefore it can handle 256 (28) characters.
- This system is formulated by the department of Electronics in India in the year 1986- 88 and recognized by Bureau of Indian Standards (BIS).
- Now this coding system is integrated with Unicode.

Unicode

- This coding system is used in most of the modern computers.
- The popular coding scheme after ASCII is Unicode.
- ASCII can represent only 256 characters.
- Therefore English and European Languages alone can be handled by ASCII.
- Particularly there was a situation, when the languages like Tamil, Malayalam, Kannada and Telugu could not be represented by ASCII.
- Hence, the Unicode was generated to handle all the coding system of Universal languages.
- This is 16 bit code and can handle 65536 characters.
- Unicode scheme is denoted by hexadecimal numbers.