7.3 Complements

In this section, we see the complement numbers used in different number systems. These complement numbers are used in case of subtraction of two numbers in corresponding number systems.

7.3.1 1's Complement Representation

The 1's complement of a binary number is the number that results when we change all 1's to zeros and the zeros to ones.

Example 7.31 : *Find 1's complement of* $(1\ 1\ 0\ 1)_2$.

Solution :

1	1	0	1	←	number
0	0	1	0	←	1's complement

Example 7.32 : *Find 1's complement of 1 0 1 1 1 0 0 1.*

Solution :

1	0	1	1	1	0	0	1	number
0	1	0	0	0	1	1	0	1's complement

7.3.2 2's Complement Representation

The 2's complement is the binary number that results when we add 1 to the 1's complement. It is given as

$$\text{2's complement} = \text{1's complement} + 1$$

The 2's complement form is used to represent negative numbers.

Example 7.33 : *Find 2's complement of* $(1\ 0\ 0\ 1)_2$.

Solution :

	1	0	0	1	number
	0	1	1	0	1's complement
+				1	
	0	1	1	1	2's complement

Example 7.34 : *Find 2's complement of* $(1\ 0\ 1\ 0\ \ 0\ 0\ 1\ 1)_2$.

Solution :

	1	0	1	0	0	0	1	1 number
	0	1	0	1	1	1	0	0 1's complement
+								1
	0	1	0	1	1	1	0	1 2's complement

⇒ 1's Complement Subtraction -

Subtraction using 1's complement are as follows:

step1(a) Find the 1's complement form of the subtrahend.

step2 (b) Add this 1's complement result to the other number.

step3 (c) If carry is there, then add it with the result of 2nd step.

step4 (d) If carry is not there, then take 1's complement of the result and put a minus sign before it.

Ex. $(1011)_2 - (1000)_2$

Step1 - Take 1's complement of subtrahend i.e. 1000 which is 0111

Step 2 -

```
  1
    1011
+   0111
-------
  1 0010
-------
```

Step 3 - Add carry with the digit 0010 thus.

```
  0010
     1
-------
  0011   Ans.
-------
```

Ex - $(1000)_2 - (1011)_2$

Step 1 - 1's complement of 1011 = 0100

Step 2 -

```
  1000
+ 0100
------
  1100
------
```

Step 3 - Since there is no carry. So take 1's complement of the result and put -Ve sign before it.

∴ 1's complement of 1100 = 0011

So Result = -0011

⇒ 2's Complement Subtraction -

Subtraction using 2's complement are as follows:

Step1 - Find 2's complement of the subtrahend

Step2 - Add this 2's complement result to the other number.

Step3 - Discard the carry, if it present

Step4 - If carry is not there, then take 2's complement of the result and put a -Ve sign before it.

Ex- $(11011)_2 - (11001)_2$ using 2's complement

Step1 2' complement of 11001 = 00110 + 1 = 00111

Step2 -

```
  1 1 1 1 1
  1 1 0 1 1
+ 0 0 1 1 1
-----------
1 0 0 0 1 0
```

Step3- Discard the carry. So the answer is 00010 or 10 Ans.

Ex- $(11001)_2 - (11011)_2$

Step1 - 2's complement of 11011 = 00100 + 1 = 00101

Step2 -

```
    1
  1 1 0 0 1
  0 0 1 0 1
-----------
  1 1 1 1 0
```

Step2 - Since there is no carry.

∴ 2's complement of 11110 = 00001 + 1 = 00010

So result is = -10 Ans.