- **From Decimal to Other Base Conversion:**

1- To convert any **positive integer** from the decimal system to other base systems, we use the Remainder method as shown below:
   1. Divide decimal number by the base (2, 8, 16).
   2. The remainder is the lowest-order digit.
   3. Repeat first two steps unit no divisor remains.

   The required binary number consists of the remainder numbers read from the last remainder to the first (note that the first remainder represents LSD while the last remaining represents MSD).

2- To convert the **fraction of decimal** to other base systems:
   1. Multiply decimal number by the base (2, 8, 16).
   2. The integer is the highest-order digit.
   3. Repeat first two steps until fraction becomes zero.

   Note that a multiplicand (here decimal fractional number) is that to be multiplied by multiplier.

Ex1:- Convert the decimal number $(112)_{10}$ into binary number.

Solution:

Division by Base	Result	Remainder (R)
112 / 2	56	0 (LSD)
56 / 2	28	0
28 / 2	14	0
14 / 2	7	0
7 / 2	3	1
3 / 2	1	1
1 / 2	0 (stop)	1 (MSD)

Now, write remainder from bottom to up, So:
The result: $(112)_{10} = (1110000)_2$

Ex2:- Convert decimal fractional number $(0.8125)_{10}$ into binary number.

Solution

Multiply by Base	Result	Carry	Reminder
0.81252 * 2	1.625	1 (LSD)	0.625
0.625 * 2	1.25	1	0.25
0.25 * 2	0.50	0	0.50
0.5 * 2	1.0	1 (MSD)	0 (stop)

Now, write these resultant integer part, this will be $(0.1101)_2$ which is equivalent binary fractional number of decimal fractional $(0.8125)_{10}$.

Ex3:- Convert decimal number $(14.78125)_{10}$ into binary number.

Solution

Integer Part				Fractional Part			
Division	Result	Remainder		Multiplication	Result	Carry	Remainder
14 / 2	7	0 ↑ LSD		0.78125 × 2	1.56250	1 LSD	0.56250
7 / 2	3	1		0.5625 × 2	1.1250	1	0.1250
3 / 2	1	1		0.1250 × 2	0.25	0	0.25
1 / 2	0 (stop)	1 MSD		0.25 × 2	0.5	0	0.5
				0.5 × 2	1.0	1 ↓ MSD	0.0 (stop)

Final result $(14.78125)_{10} = (1110.11001)_2$

Ex4:- Convert the decimal number $(87)_{10}$ into octal number.

Solution:

Division by Base	Result	Remainder (R)
87 / 8	10	7 ↑ (LSD)
10 / 8	1	2
1 / 8	0 (stop)	1 (MSD)

Now, write remainder from bottom to up, So:
The result: $(87)_{10} = (127)_8$

Ex5:- Convert the decimal number $(156)_{10}$ into octal number.

Solution:

Division by Base	Result	Remainder (R)
156 / 8	19	4 ↑ (LSD)
19 / 8	2	3
2 / 8	0 (stop)	2 (MSD)

Now, write remainder from bottom to up, So:
The result: $(156)_{10} = (234)_8$

Ex6:- Convert decimal number $(39.125)_{10}$ into octal number.

Solution:

Integer Part				Fractional Part			
Division	Result	Remainder		Multiplication	Result	Carry	Remainder
39 / 8	4	7 ↑ LSD		0.125 × 8	1. 0	1 LSD	0.0 (stop)
4 / 8	0 (stop)	4 MSD					

Final result $(39.125)_{10} = (47.1)_8$

Ex6:- Convert decimal number $(35.45)_{10}$ into octal number.

Solution:

Integer Part				Fractional Part			
Division	Result	Remainder		Multiplication	Result	Carry	Remainder
35 / 8	4	3 ↑ LSD		0.45 × 8	3.6	3 LSD	0.6
4 / 8	0 (stop)	4 MSD		0.6 × 8	4.8	4	0.8
				0.8 × 8	6.4	6	0.4
				0.4 × 8	3.2	3	0.2
				0.2 × 8	1.6	1 ↓ MSD	0.6 (stop)

Final result $(35.45)_{10} = (43.34631)_{8}$

Ex7:- Convert the decimal number $(1000)_{10}$ into hexadecimal number.

Solution:

Division by Base	Result	Remainder (R)
1000 / 16	62	8 ↑ (LSD)
62 / 16	3	14
3 / 16	0 (stop)	3 (MSD)

Now, write remainder from bottom to up, So:
The result: $(120)_{10} = (3E8)_{16}$

Ex8:- Convert decimal number $(43.125)_{10}$ into hexadecimal number.

Solution:

Integer Part				Fractional Part			
Division	Result	Remainder		Multiplication	Result	Carry	Remainder
43 / 16	2	11 ↑ LSD		0.125 × 16	2.0	2	0.0 (stop)
2 / 16	0 (stop)	2 MSD					

Final result $(35.45)_{10} = (2B.2)_{16}$

Ex6:- Convert decimal number $(188.342)_{10}$ into hexadecimal number. (Precision= 4)

Solution:

Integer Part				Fractional Part			
Division	Result	Remainder		Multiplication	Result	Carry	Remainder
188 / 16	11	12 ↑ LSD		0.342 × 16	5.472	5 LSD	0.472
11 / 16	0 (stop)	11 MSD		0.472 × 16	7.552	7	0.552
				0.552 × 16	8.832	8	0.832
				0.832 × 16	13.312	13 ↓ MSD	0.312

Final result $(188.342)_{10} \approx (BC.578D)_{16}$

2- Converting Binary to/from Octal Number:

Important notes to remember:

Binary Base = 2	Octal Base = 8 = 2^3
Binary Digits: [0,1]	Octal Digits: [0, 1, 2, 3, 4, 5, 6, 7]

Binary	Octal
000	0
001	1
010	2
011	3
100	4
101	5
110	6
111	7

2^2 = 4	2^1 = 2	2^0 = 1	
Binary			Octal
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

- **From Binary to Octal Conversion:**

To understand the way, let us take the following examples:

Ex1:- Convert binary number $(10110110)_2$ into octal number.

10110110 ←				
0 1 0		1 1 0		1 1 0
× × ×		× × ×		× × ×
4 2 1		4 2 1		4 2 1
0 + 2 + 0		4 + 2 + 0		4 + 2 + 0
2		6		6
266				

Final result $(10110110)_2 = (266)_8$

Ex2:- Convert binary number $(1100.1011)_2$ into octal number.

1100.1011 ⟵ ⟶								
Integer Part 1100 ⟵				Fractional Part 1011 ⟶				
0 0 1		1 0 0		1 0 1		1 0 0		
× × ×		× × ×		× × ×		× × ×		
4 2 1		4 2 1		4 2 1		4 2 1		
0 + 0 + 1		4 + 0 + 0		4 + 0 + 1		4 + 0 + 0		
1		4		5		4		
14				54				

Final result $(1100.1011)_2 = (14.54)_8$

Ex3:- Convert binary number $(110111)_2$ into octal number.

110111 ⟵		
1 1 0		1 1 1
6		7
67		

Final result $(110111)_2 = (67)_8$

- **From Octal to Binary Conversion:**

- **Ex1:- Convert octal number $(375)_8$ into binary number.**

375		
3	7	5
0 1 1	1 1 1	1 0 1

Final result $(375)_8 = (11111101)_2$

- **Ex2:- Convert octal number $(53.76)_8$ into binary number.**

53.76														
5				3			.	7				6		
1	0	1		0	1	1	.	1	1	1		1	1	0

Final result $(53.76)_8 = (101011.11111)_2$

3- Converting Binary to/from Hexadecimal Number:

Important notes to remember:

Binary Base = 2	Hexadecimal Base = 16 = 2^4
Binary Digits: [0,1]	Hexadecimal Digits: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F]

Binary	Hexadecimal
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	A
1011	B
1100	C
1101	D
1110	E
1111	F

$2^3 = 8$	$2^2 = 4$	$2^1 = 2$	$2^0 = 1$	
Binary				Hexadecimal
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	A
1	0	1	1	B
1	1	0	0	C
1	1	0	1	D
1	1	1	0	E
1	1	1	1	F

- **From Binary to Hexadecimal Conversion:**

To understand the way, let us take the following examples:

Ex1:- Convert binary number $(1010110110)_2$ into hexadecimal number.

1010110110 ←											
0	0	1	0		1	0	1	1		0	1	1	0
×	×	×	×		×	×	×	×		×	×	×	×
8	4	2	1		8	4	2	1		8	4	2	1
0 + 0 + 2 + 0					8 + 0 + 2 + 1					0 + 4 + 2 + 0			
2					B					6			
2B6													

Final result $(1010110110)_2 = (2B6)_{16}$

Ex2:- Convert binary number $(101101)_2$ into hexadecimal number.

100101101 ←											
0	0	0	1		0	0	1	0		1	1	0	1
1					2					D			

Final result $(100101101)_2 = (2B6)_{16}$

Ex3:- Convert binary number $(1010101011.1001)_2$ into hexadecimal number.

1010101011.1001 ← →																			
Integer Part 1010101011 ←																Fractional Part 1001 →			
0	0	1	0		1	0	1	0		1	0	1	1		1	0	0	1
×	×	×	×		×	×	×	×		×	×	×	×		×	×	×	×
8	4	2	1		8	4	2	1		8	4	2	1		8	4	2	1
0 + 0 + 2 + 0					8 + 0 + 2 + 0					8 + 0 + 2 + 1					8 + 0 + 0 + 1			
2					A					B					9			

Final result $(1010101011.1001)_2 = (2AB.9)_{16}$

- **From Hexadecimal to Binary Conversion:**

- **Ex1:- Convert hexadecimal number $(5B)_{16}$ into binary number.**

5B		
5		B
0 1 0 1		1 0 1 1

Final result $(5B)_{16} = (01011011)_2$

- **Ex2:- Convert hexadecimal number $(2C.A5)_{16}$ into binary number.**

2C.A5																	
2					C				.	A					5		
0	0	1	0		1	1	0	0	.	1	0	1	0		0	0	1	1

Final result $(2C.A5)_{16} = (00101100.10100011)_2$

4- Converting Octal to/from Hexadecimal Number:

- **From Octal to Hexadecimal Conversion:**

Steps:

1- Convert from Octal to Binary
2- Convert from Binary to Hexadecimal

Ex1:- Convert octal number $(753)_8$ into hexadecimal number.

First Step:

753		
7	5	3
1 1 1	1 0 1	0 1 1

$(111101011)_2$

Second Step:

111101011													
0	0	0	1		1	1	1	0		1	0	1	1
1					E					B			

Final result $(753)_8 = (1EB)_{16}$

Ex2:- Convert octal number $(325.67)_8$ into hexadecimal number.

- **From Hexadecimal to Octal Conversion:**

Steps:

3- Convert from Hexadecimal to Binary
4- Convert from Binary to Octal

Ex1:- Convert hexadecimal number $(56A)_{16}$ into octal number.

First Step:

56A													
5					6					A			
0	1	0	1		0	1	1	0		1	0	1	0

$(010101101010)_2$

Second Step:

010101101010														
0	1	0		1	0	1		1	0	1		0	1	0
2				5				5				2		

Final result $(56A)_{16} = (2552)_8$

Ex2:- Convert hexadecimal number $(45.6C)_{16}$ into octal number.