Number system :- A number system of base also called radix are is a system which have 'r' distinct symbols for 'r' digits. A number is represented by a string of these symbolic digits. To determine the quantity that the number represents we multiply the number by an integer power of 'r' depending on the place it is located and then find the sum of weighted digits.

Decimal numbers:- Decimal number systems have 10 digits represented by 0 1 2 3 4 5 6 7 8 and 9. Any decimal number can be represented as a string of these digits and since there are 10 decimal digits, therefore, the base or radix of this system is 10.

Thus a string of number 234.5 can be represented in quantity as

$$2 \times 10^{-2} + 3 \times 10^{-1} + 4 \times 10^{0} + 5 \times 10^{-1}$$

Binary numbers:- In binary numbers we have two digits '0' and '1' and they can also be represented as a string of these two digits. The base of the binary number system is 2.

Octal numbers:- An Octal system have 8 digits represented as 0 1 2 3 4 5 6 and 7. Any octal number can be represented as a string of these 8 digits, therefore the base or radix of this number is 8.

Hexadecimal numbers:- The hexadecimal system have 16 digits which are represented as 0 1 2 3 4 5 6 7 8 9 A B C D E and F. Any hexadecimal number can be represented as a string of these 16 digits therefore the base or radix of this number is 16.

Conversion

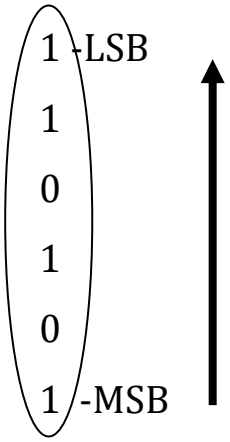
Decimal to binary :- The method of converting decimal number to binary involves dividing the number by 2, and again dividing the resulting quotient by 2. This process will continue until the quotient is not zero. The sequence of reminders

obtained from these divisions is the binary equivalent of the decimal number where the first remainder obtained is least significant bit LSB and the last reminder is the most significant bit MSB.

Ex:-

Convert 43 into binary equivalent

Number	Divisor	Quotient	Remainder
43	2	21	1 -LSB
21	2	10	1
10	2	5	0
5	2	2	1
2	2	1	0
1	2	0	1 -MSB



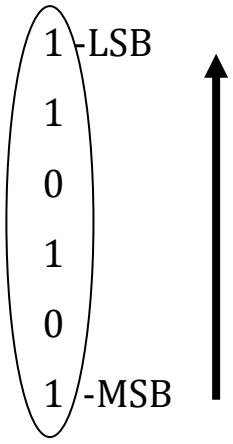
Result is 101011

Note:- For converting decimal number to binary in fractional part are handled separately. To convert fractional part multiply the fraction part by 2 repeatedly and separate the integer as you get it till you have all the zeros in fraction.

Ex:- Convert 43.125

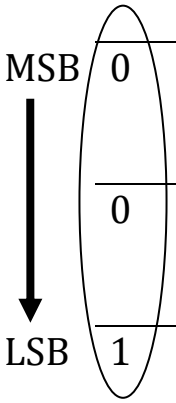
Integer Part

Number	Divisor	Quotient	Remainder
43	2	21	1 -LSB
21	2	10	1
10	2	5	0
5	2	2	1
2	2	1	0
1	2	0	1 -MSB



Fractional part

	.	1	2	5
			X	2
MSB 0	.	2	5	0
			X	2
0	.	5	0	0
			X	2
LSB 1	.	0	0	0



Result :- **101011.001**

Decimal to Octal:- The method of converting decimal number to octal involves dividing a number by 8, and again dividing the resulting quotient by 8. This process continues until the quotient is not zero. The sequence of reminders obtained from these division is octal equivalent of the decimal number where the first remainder obtained is LSB and last remainder is MSB.

Ex:- Convert $(145)_{10}$ into Octal.

Number	Divisor	Quotient	Remainder	
145	8	18	1	LSB
18	8	2	2	
2	8	0	2	MSB

Result $145_{10} = (221)_8$

Convert 0.635_{10} to Octal

	.	6	3	5	
			X	8	
MSB 5	.	0	8	0	
			X	8	
0	.	6	4	0	
			X	8	
5	.	1	2	0	
			X	8	
LSB 0	.	9	6	0	

Result $0.635_{10} = (5050)_8$

Decimal to Hexadecimal:- Method of converting decimal number to hexadecimal involves dividing the number by 16, and again dividing the resulting question by 16 this process continues until the quotient is not zero. The sequence of remainder obtained from these divisions is hexadecimal equivalent. Sequence is noted from MSB to LSB.

Ex:- Convert the decimal number $(140)_{10}$ into hexadecimal.

Number	Divisor	Quotient	Remainder	
140	16	8	12 or (C)	LSB ↑
8	16	0	8	MSB

Result = $(140)_{10}$ =$(8C)_{16}$

Convert $(0.520)_{10}$ into Hexadecimal

		.	5	2	0
				X	16
MSB	8	.	3	2	0
				X	16
	5	.	1	2	0
				X	16
	1	.	9	2	0
				X	16
	(E)14	.	7	2	0
				X	16
LSB	(B)11	.	5	2	0

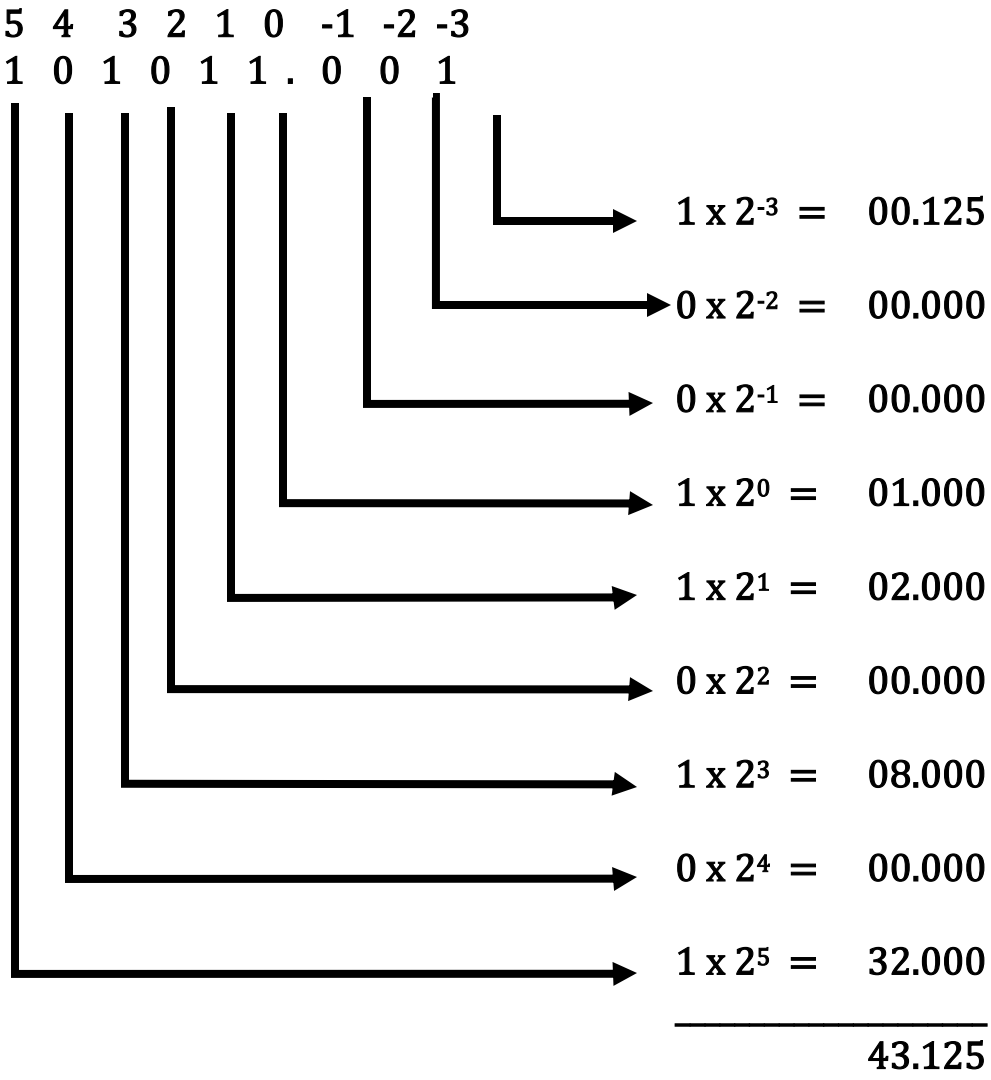
Result:-

$(0.520)_{10}$= $(851EB)_{16}$

Deepak Kumar
Asst. Prof. Dept. of Computer Science, Shershah College Sasaram

Binary to Decimal:- To convert a binary number into its decimal equivalent the decimal values of all the bits are added to give the decimal number. The decimal value of nth bit is: **nth bit X 2^{n-1}**

Ex:- Convert (101011.001)



Binary to Octal:- For converting binary to octal, binary number is divided into groups of three, which are then combined by place value to generate equivalent octal.

Ex:- Convert $(1\ 1\ 0\ 1\ 0\ 1\ 1\ .\ 0\ 0\ 1\ 0\ 1)_2$ to Octal equivalent.

0 0 1 1 0 1 0 1 1 . 0 0 1 0 1 0

1 5 3 . 1 2 ➔ Result is $(153.12)_8$