

Octal Number System

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The octal number system is a base-8 system using digits (0–7): 0, 1, 2, 3, 4, 5, 6, and 7.

For example: 22_8 , 13_8 , 17_8 , etc, are octal numbers.

It is widely used in computer programming as a compact representation of binary numbers, where each octal digit corresponds to three binary digits.

In this article, we will discuss the Octal Number System, Octal Number System Conversions, Octal Number System Examples, and Others in detail.

Octal Number System Table

The table below shows the relationship between octal and binary numbers (each octal digit represents 3 bits in binary):

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

Octal to Binary Conversion Table

'OCTAL' is derived from the Latin word 'OCT' which means Eight. The number

system with base 8 and symbols ranging between 0-7 is known as the Octal Number System. Each digit of an octal number represents a power of 8. It is widely used in computer programming and digital systems. Octal number system can be converted to other number systems and visa versa.

For example, an octal number $(10)_8$ is equivalent to 8 in the decimal number system, 001000 in the binary number system and 8 in the hexadecimal number system.

Now, we will learn about the conversion of octal number system to other number systems one by one. So let's get started.

Conversion from Octal to Other Number Systems

Octal Numbers are represented with digits 0-7 and with base 8. Conversion of a number system means conversion from one base to another. Following are the conversions of the Octal Number System to other Number Systems:

Octal to Decimal Conversion

Octal numbers are represented in base 8, but the decimal numbers are of base 10. Hence, to convert an octal number to a decimal number, the base of that number is to be changed.

Example: $(247)_8$ is to be converted to decimal:

Octal to Decimal Conversion

$$(247)_8 \longrightarrow (?)_{10}$$
$$2 \times 8^2 + 4 \times 8^1 + 7 \times 8^0$$
$$2 \times 64 + 4 \times 8 + 7$$
$$128 + 32 + 7$$
$$(167)_{10}$$

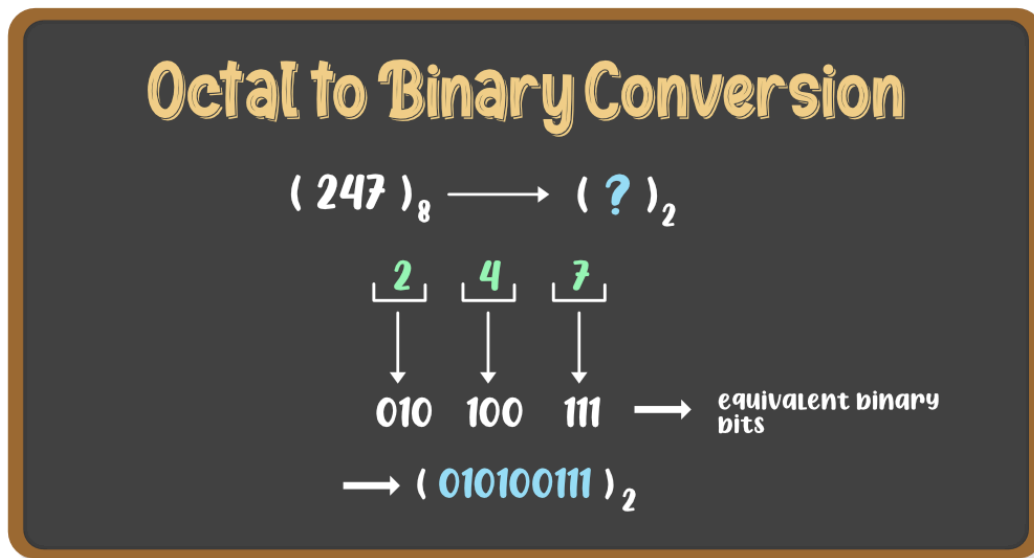
Follow the steps given below:

- **Step 1:** Multiply each digit of the Octal number with the place value of that digit, starting from right to left i.e. from LSB to MSB.
- **Step 2:** Add the result of this multiplication and the decimal number will be formed.

Octal to Binary Conversion

Octal numbers are represented in base 8, but the binary numbers are of base 2. Hence, to convert an octal number to a binary number, the base of that number is to be changed.

Example: $(247)_8$ is to be converted to binary



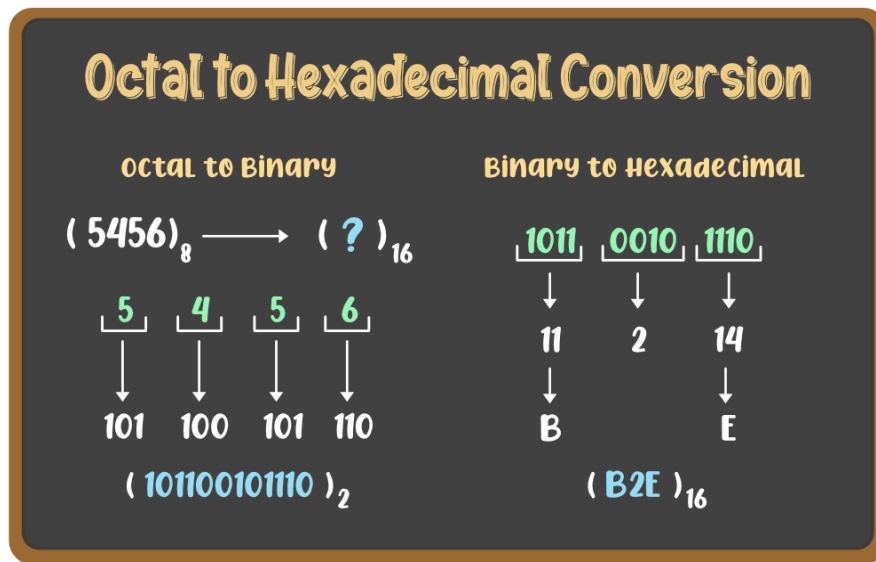
Follow the steps given below:

- **Step 1:** Write each digit of the octal number separately.
- **Step 2:** Convert each digit into an equivalent group of three binary digits.
- **Step 3:** Combine these groups to form the whole binary number.

Octal to Hexadecimal Conversion

Octal numbers are represented in base 8, but the hexadecimal numbers are of base 16. Hence, to convert an octal number to a hex number, the base of that number is to be changed.

Example: $(5456)_8$ is to be converted to hex



Follow the steps given below:

- **Step 1:** We need to convert the Octal number to Binary first. For that, follow the steps given in the above conversion.
- **Step 2:** Now to convert the binary number to Hex number, divide the binary digits into groups of four digits starting from right to left i.e. from LSB to MSB.
- **Step 3:** Add zeros before MSB to make it a proper group of four digits(if required)
- **Step 4:** Now convert these groups into their relevant decimal values.
- **Step 5:** For values from 10-15, convert it into Hex symbols i.e from A-F

Decimal to Octal Conversion

The image added below shows binary to octal conversion.

Decimal to Octal Conversion

$$(243)_{10} \longrightarrow (?)_8$$

8	243	3	↑
8	30	6	
	3		

 $\longrightarrow (363)_8$

Follow the steps given below:

To convert a decimal number to an octal number follow these simple steps:

- **Step 1:** Divide the given decimal number by 8.
- **Step 2:** Write down the quotient and remainder obtained.
- **Step 3:** Divide the quotient obtained by 8.
- **Step 4:** Repeat step 2 and step 3 until the quotient becomes 0.
- **Step 5:** Write the obtained remainder in reverse order.

Octal Multiplication Table

Octal Multiplication table is added below,

×	0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7
2	0	2	4	6	10	12	14	16
3	0	3	6	11	14	17	22	25

×	0	1	2	3	4	5	6	7
4	0	4	10	14	20	24	30	34
5	0	5	12	17	24	31	36	43
6	0	6	14	22	30	36	44	52
7	0	7	16	25	34	43	52	61

Also Check:

- [Whole Numbers](#)
- [Natural Numbers](#)
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Solved Examples on Octal Numbers System

Example 1: What is Decimal Equivalent of 1121_8 ?

Solution:

$$1121_8 = 1 \times 8^3 + 1 \times 8^2 + 2 \times 8^1 + 1 \times 8^0$$

$$1121_8 = 1 \times 512 + 1 \times 64 + 2 \times 8 + 1 \times 1$$

$$1121_8 = 512 + 64 + 16 + 1 = 593$$

$$\text{Hence, } 1121_8 = 593_{10}$$

Example 2: Convert 27_8 into the binary number.

Solution:

Write binary equivalent of each digit of 27_8

2 ---> 010

7 ---> 111

$$\text{Hence } 27_8 = 010111_2$$

Example 3: Find the octal equivalent of 1001001_2 .

Solution:

Breaking 10101111 into groups of three starting from rightmost digit and adding leading zeroes we get:

$001, 001, 001$

Write the octal equivalent of the groups formed

$001 \rightarrow 1$

$001 \rightarrow 1$

$001 \rightarrow 1$

Answer is $(111)_8$

Example 4: Represent 123_8 as a Decimal Number.

Solution:

$$123_8 = 1 \times 8^2 + 2 \times 8^1 + 3 \times 8^0$$

$$\Rightarrow 123_8 = 1 \times 64 + 2 \times 8 + 3 \times 1$$

$$\Rightarrow 123_8 = 64 + 16 + 3$$

$$\Rightarrow 123_8 = 83_{10}$$

Hence 83_{10} is decimal representation of 123_8 .

Practice Questions on Octal Number System

Question 1: Convert 121_{10} to an octal number.

Question 2: What is Octal Value of 100010000_2 ?

Question 3: Find the Decimal Equivalent of 55_8 .

Question 4: Convert $12F_{16}$ to Octal number.

Question 5: What will be the binary value of 57_8 ?

Answer Key:

- **171**
- **420**
- **45**
- **457**

- *101111*

Suggested Quiz

10 Questions

What is the decimal equivalent of the octal number 57?

- ☐ A 47
- ☐ B 45
- ☐ C 41
- ☐ D 49

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1/10

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