NUMBER SYSTEMS:

1-Decimal Number System:

The decimal numeral system (also called base ten or occasionally denary) has ten as its base. It is the most widely numerical base. Decimal notation is the writing of numbers in a base-10 numeral system.
Positional decimal systems include a zero and use symbols (called digits) for the ten values (0, 1, 2, 3, 4, 5, 6, 7, 8, and 9) to represent any number, no matter how large or how small. These digits are often used with a decimal separator which indicates the start of a fractional part, and with a symbol such as the plus sign + (for positive) or minus sign − (for negative) adjacent to the numeral to indicate its polarity.

2-Binary Number System

The binary numeral system, or base-2 number system represents numeric values using two symbols, 0 and 1. More specifically, the usual base-2 system is a positional notation with a radix of 2. Owing to its straightforward implementation in digital electronic circuitry using logic gates, the binary system is used internally by all modern computers.

Representation

100101 binary (explicit statement of format)

100101b (a suffix indicating binary format)

100101B (a suffix indicating binary format)

100101_2 (a subscript indicating base-2 (binary notation)

3-Octal Number System

The octal numeral system, or oct for short, is the base-8 number system, and uses the digits 0 to 7. Numerals can be made from binary numerals by grouping consecutive binary digits into groups of three (starting from the right). For example, the binary representation for decimal 74 is 1001010, which can be grouped into (00)1 001 010 — so the octal representation is 112.
In decimal systems each decimal place is a base of 10. For example:

$$\mathbf{74}_{10} = \mathbf{7} \times 10^1 + \mathbf{4} \times 10^0$$

In octal numerals each place is a power with base 8. For example:

$$\mathbf{112}_8 = \mathbf{1} \times 8^2 + \mathbf{1} \times 8^1 + \mathbf{2} \times 8^0$$

By performing the calculation above in the familiar decimal system we see why 112 in octal is equal to 64+8+2 = 74 in decimal.

4- Hexadecimal Number System

In mathematics and computer science, hexadecimal (also base 16, or hex) is a positional numeral system with a radix, or base, of 16. It uses sixteen distinct symbols, most often the symbols 0–9 to represent values zero to nine, and A, B, C, D, E, F (or alternatively a through f) to represent values ten to fifteen. For example, the hexadecimal number 2AF3 is equal, in decimal, to (2 × 163) + (10 × 162) + (15 × 16) + 3, or 10,995.

Conversion from one number system to another

1-Decimal to binary

To convert from a base-10 integer numeral to its base-2 (binary) equivalent, the number is divided by two, and the remainder is the least-significant bit. The (integer) result is again divided by two, its remainder is the next most significant bit.

EXAMPLE 1: convert (25) decimal to binary

decimal	Divided by 2	remainder
25	2	1
12	2	0
6	2	0
3	2	1
1	2	1

The binary number : (11001)B

EXAMPLE 2: convert (36) decimal to binary

decimal	Divided by 2	remainder
36	2	0
18	2	0
9	2	1
4	2	0
2	2	0
1	2	1

The binary number : (100100)B

EXAMPLE 3: convert (120) decimal to binary

decimal	Divided by 2	remainder
120	2	0
60	2	0
30	2	0
15	2	1
7	2	1
3	2	1
1	2	1

The binary number : (1111000)B

EXAMPLE 4: convert (570) decimal to binary

decimal	Divided by 2	remainder
570	2	0
285	2	1
142	2	0
71	2	1
35	2	1
17	2	1
8	2	0
4	2	0
2	2	0
1	2	1

The binary number : (1000111010)B

H.W: convert all the following decimal number to binary number

1-(43)D ⟶ ( )B
2-(87)D ⟶ ( )B
3-(987)D ⟶ ( )B
4-(879)D ⟶ ( )B
5-(567)D ⟶ ( )B

2-Decimal to octal

To convert integer decimals to octal, divide the original number by the largest possible power of 8.

EXAMPLE 1: convert (25) decimal to octal

decimal	Divided by 8	remainder
25	8	1
3	8	3

The octal number : (31)**O**

EXAMPLE 2: convert (120) decimal to octal

decimal	Divided by 8	remainder
120	8	0
15	8	7
1	8	1

The octal number : (170)**O**

EXAMPLE 3: convert (135) decimal to octal

decimal	Divided by 8	remainder
135	8	7
16	8	0
2	8	2

The octal number : (207)**O**

H.W: convert all the following decimal number to octal number

1-(36)D → **( )O**
2-(124)D → **( )O**
3-(342)D → **( )O**
4-(345)D → **( )O**
5-(675)D → **( )O**

3-Decimal to hexadecimal

To convert integer decimals to hexadecimal, divide the original number by the largest possible power of 16.

EXAMPLE 1: convert (25) decimal to hexadecimal

decimal	Divided by 16	remainder
25	16	9
1	16	1

The hexadecimal number : (19)**H**

EXAMPLE 2: convert (180) decimal to hexadecimal

decimal	Divided by 16	remainder
180	16	4
11	16	B

The hexadecimal number : (B4)**H**

EXAMPLE 3: convert (140) decimal to hexadecimal

decimal	Divided by 16	remainder
140	16	C
8	16	8

The hexadecimal number : (8C)**H**

H.W: convert all the following decimal number to hexadecimal number

1-(360)D ⟶ ( )H
2-(104)D ⟶ ( )H
3-(340)D ⟶ ( )H
4-(305)D ⟶ ( )H
5-(605)D ⟶ ( )H

4-Binary to Decimal

EXAMPLE 1: convert (1111) binary to decimal

Binary	1	1	1	1
Convert	$1*2^3$	$1*2^2$	$1*2^1$	$1*2^0$
Decimal	8	4	2	1

8+4+2+1=(15)D

EXAMPLE 2: convert (111001) binary to decimal

Binary	1	1	1	0	0	1
Convert	$1*2^5$	$1*2^4$	$1*2^3$	$0*2^2$	$0*2^1$	$1*2^0$
Decimal	32	16	8	0	0	1

32+16+8+1=(57)D

EXAMPLE 3: convert (11001) binary to decimal

Binary	1	1	0	0	1
Convert	$1*2^4$	$1*2^3$	$0*2^2$	$0*2^1$	$1*2^0$
Decimal	16	8	0	0	1

16+8+1=(25)D

5-Binary to Octal

The binary digits are grouped by threes, starting from the decimal point and proceeding to the left and to the right. Add leading 0s to fill out the last group of three if necessary**.**

(000)B ⟶ (0)O
(001)B ⟶ (1)O
(010)B ⟶ (2)O
(011)B ⟶ (3)O
(110)B ⟶ (4)O
(101)B ⟶ (5)O
(110)B ⟶ (6)O
(111)B ⟶ (7)O

EXAMPLE 1: convert (1010111100) binary to octal

Binary	001	010	111	100
Octal	1	2	7	4

The octal number : (1274)**O**

EXAMPLE 2: convert (101111010110) binary to octal

Binary	101	111	010	110
Octal	5	7	2	6

The octal number : (5726)**O**

EXAMPLE 3: convert (10111110001110110) binary to octal

Binary	010	111	110	001	110	110
Octal	2	7	5	1	6	6

The octal number : (275166)**O**

6-Binary to Hexadecimal

it is trivial to regard the binary string as 4-digit groups and map each to a single hexadecimal digit.

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

EXAMPLE 1: convert (01011110101101010010) binary to hexadecimal

Binary	0101	1110	1011	0101	0010
hexa	5	E	B	5	2

The octal number : (5EB52)**H**

EXAMPLE 2: convert (1100110010101011110) binary to hexadecimal

Binary	0110	0110	0101	0101	1110
hexa	6	6	5	5	E

The octal number : (6655E)**H**

7-Octal to decimal

EXAMPLE 1: convert (2764) octal to decimal

Octal	2	7	6	4
Convert	$2*8^3$	$7*8^2$	$6*8^1$	$4*8^0$
Decimal	1024	448	48	4

1024+448+48+4=(1524)D

EXAMPLE 2: convert (254) octal to decimal

Octal	2	5	4
Convert	$2*8^2$	$5*8^1$	$4*8^0$
Decimal	128	40	4

128+40+4=(172)D

EXAMPLE 3: convert (435) octal to decimal

Octal	4	3	5
Convert	$4*8^2$	$3*8^1$	$5*8^0$
Decimal	256	24	5

256+24+5=(285)D

8-Octal to Binary

To convert octal to binary, replace each octal digit by its binary representation.

(0)O ⟶ (000)B
(1)O ⟶ (001)B
(2)O ⟶ (010)B
(3)O ⟶ (011)B
(4)O ⟶ (110)B
(5)O ⟶ (101)B
(6)O ⟶ (110)B
(7)O ⟶ (111)B

EXAMPLE 1: convert (27643) octal to binary

Octal	2	7	6	4	3
Binary	010	111	110	100	011

The binary number : (010111110100011)B

EXAMPLE 2: convert (23453) octal to binary

Octal	2	3	4	5	3
Binary	010	011	100	101	011

The binary number : (010011100101011)B

EXAMPLE 3: convert (46534) octal to binary

Octal	4	6	5	3	4
Binary	100	110	101	011	100

The binary number : (100110101011100)B

9-Octal To hexadecimal

The conversion is made in two steps using binary as an intermediate base. Octal is converted to binary and then binary to hexadecimal, grouping digits by fours, which correspond each to a hexadecimal digit.

Example1: convert octal 1057 to hexadecimal

First step convert it to binary number

(1057)O=(001000101111)B

second step convert it to hexadecimal number

(001000101111)B=(22F)H

10-hexadecimal to decimal

EXAMPLE 1: convert (1AB2) hexadeciml to decimal

Hexa	1	A	B	2
Convert	$1*16^3$	$10*16^2$	$11*16^1$	$2*16^0$
Decimal	4096	2560	176	2

4096+2560+176+2=(6834)D

EXAMPLE 2: convert (DFE5) hexadeciml to decimal

Hexa	D	F	E	5
Convert	$13*16^3$	$15*16^2$	$14*16^1$	$5*16^0$
Decimal	53248	3840	224	5

53248+3840+224+5=(57317)D

11- hexadecimal to Binary

To convert hexadecimal to binary, replace each hexadecimal digit by its binary representation.

(0)H ⟶ (0000)B
(1)H ⟶ (0001)B
(2)H ⟶ (0010)B
(3)H ⟶ (0011)B
(4)H ⟶ (0110)B
(5)H ⟶ (0101)B
(6)H ⟶ (0110)B
(7)H ⟶ (0111)B
(8)H ⟶ (1000)B
(9)H ⟶ (1001)B
(A)H ⟶ (1010)B
(B)H ⟶ (1011)B
(C)H ⟶ (1110)B
(D)H ⟶ (1101)B
(E)H ⟶ (1110)B
(F)H ⟶ (1111)B

EXAMPLE 1: convert (1011101010111100) binary to hexadecimal

Binary	1011	1010	1011	1100
Octal	B	A	B	C

The hexadecimal number : (BABC)**O**

12-Octal To hexadecimal

The conversion is made in two steps using binary as an intermediate base. hexadecimal is converted to binary and then binary to octal, grouping digits by threes, which correspond each to a octal digit.

Example1: convert hexadecimal AB6 to octal

First step convert it to binary number

(AB6)H=(101010110110)B

second step convert it to octal number

(101010110110)B=(5266)O