SNS COLLEGE OF ENGINEERING

(Autonomous)

DEPARTMENT OF CSE - IoT

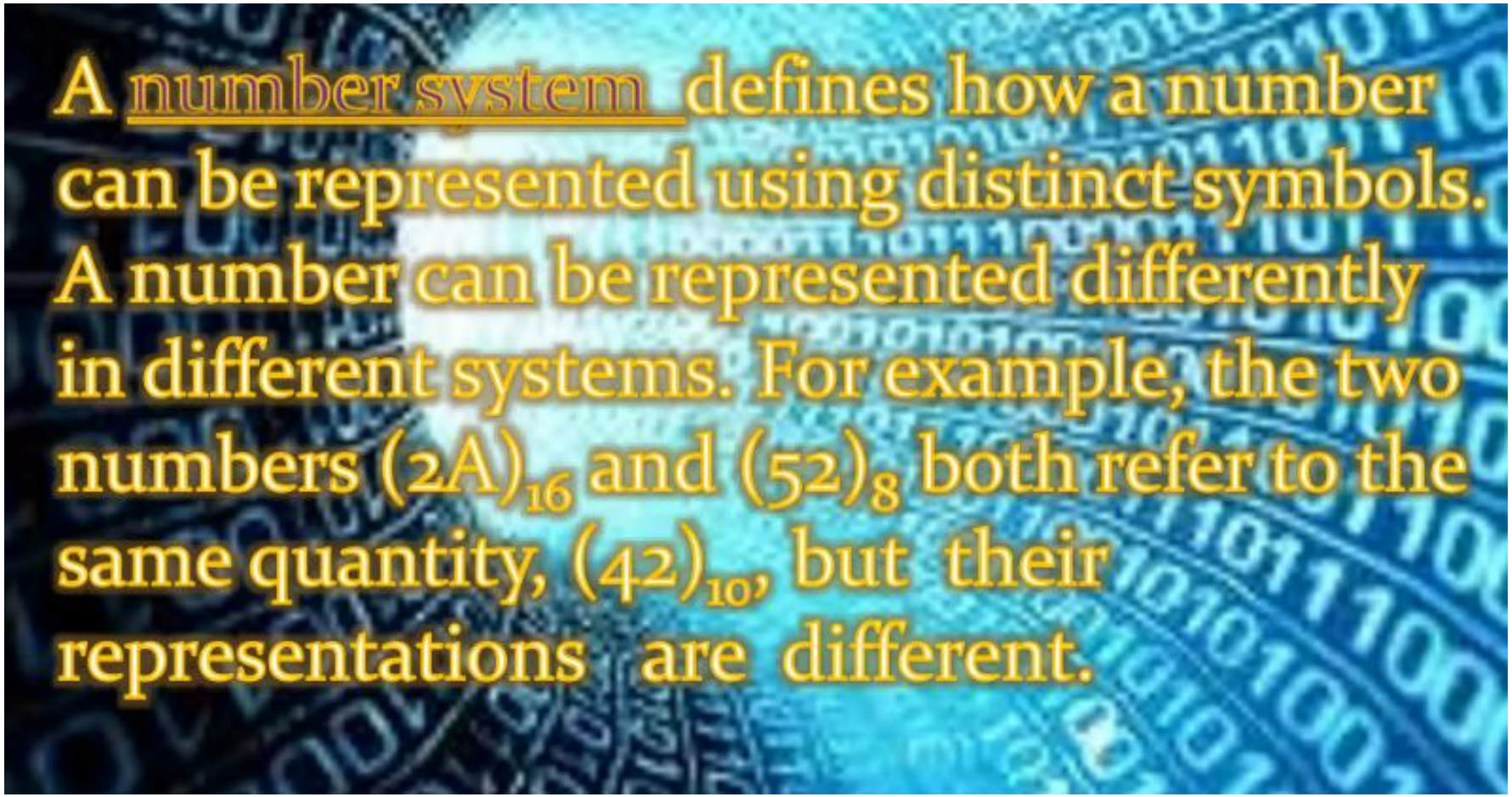
COURSE NAME:19EC306 / DIGITAL CIRCUITS

II YEAR/III SEMESTER

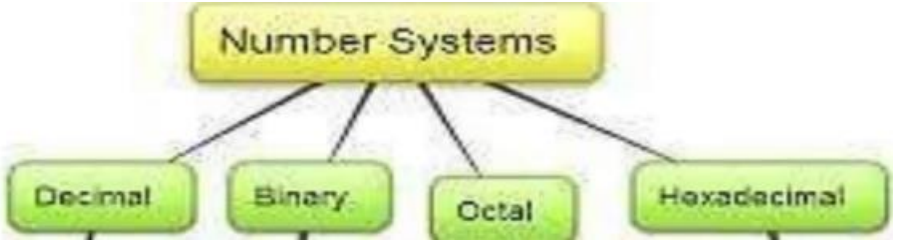
UNIT:1- MINIMIZATION TECHNIQUES AND LOGIC GATES

TOPIC:NUMBER SYSTEMS

INTRODUCTION



NUMBER SYSTEM CLASSIFICATION



Numbering Systems		
System	Base	Digits
Binary	2	0 1
Octal	8	0 1 2 3 4 5 6 7
Decimal	10	0 1 2 3 4 5 6 7 8 9
Hexadecimal	16	0 1 2 3 4 5 6 7 8 9 A B C D E F

Two types of Number Systems

- Positional Number System

- **Characteristics**
  - Use only a few symbols called digits
  - These symbols represent different values depending on the position they occupy in the number

- Non Positional Number System

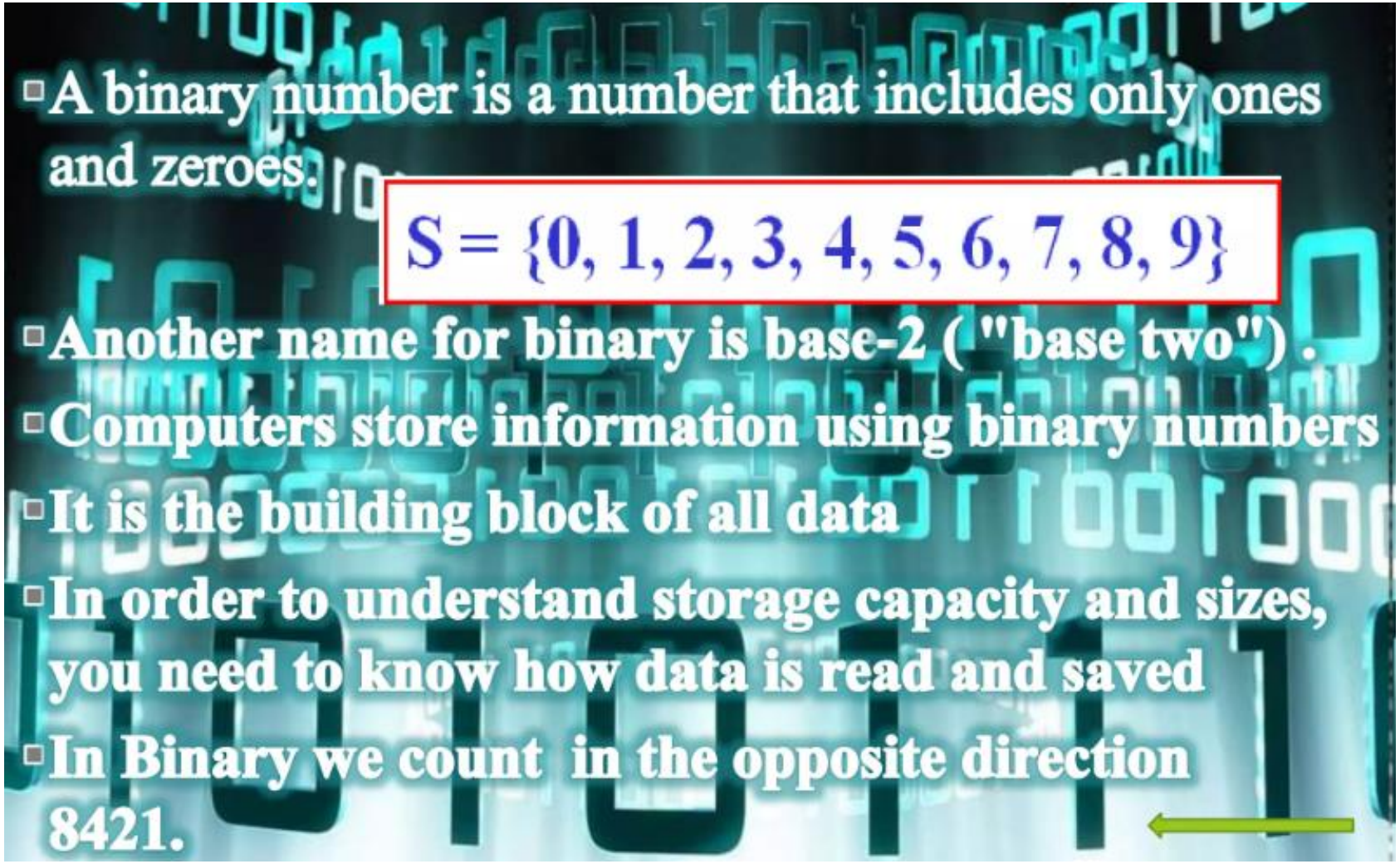
- **Characteristics**
  - Use symbols such as I for 1, II for 2, III for 3, IIII for 4, IIIII for 5, etc
  - Each symbol represents the same value regardless of its position in the number
  - The symbols are simply added to find out the value of a particular number
- **Difficulty**
  - It is difficult to perform arithmetic with such a number system

- The value of each digit is determined by:
  1. The digit itself
  2. The position of the digit in the number
  3. The base of the number system

(**base** = total number of digits in the number system)

- The maximum value of a single digit is always equal to one less than the value of the base

WHAT IS A BINARY NUMBER??



CONVERSION OF BINARY TO DECIMAL

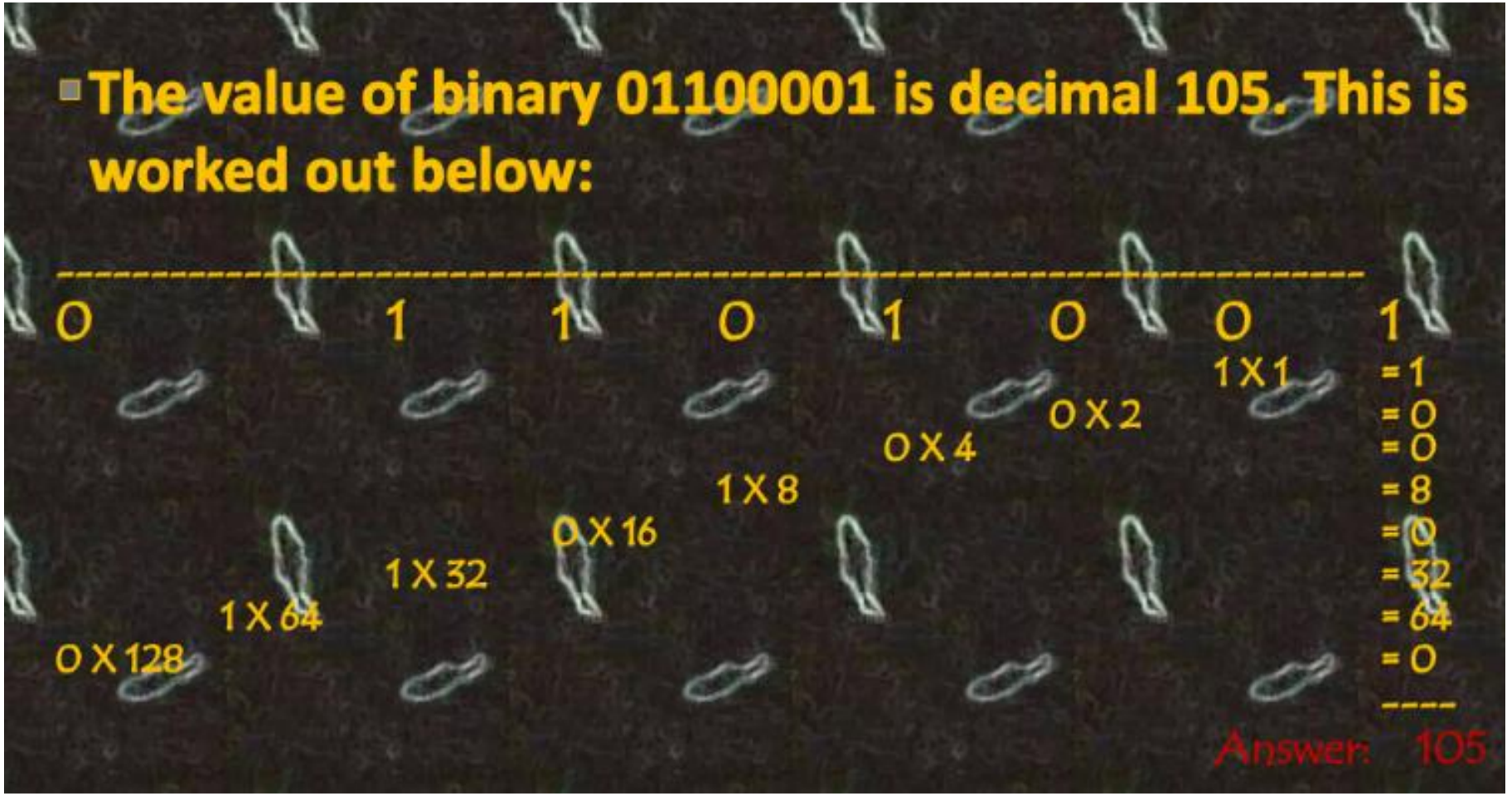
1. The first position value is 2^0 , i.e. one
2. The 2nd position value is 2^1 , i.e. two
3. The 2nd position value is 2^2 , i.e. four
4. The 2nd position value is 2^3 , i.e. eight
5. The 2nd position value is 2^4 , i.e. sixteen etc.

$$10001011_2$$

$$= 1\times2^7 + 0\times2^6 + 0\times2^5 + 0\times2^4 + 1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0$$

$$= 128 + 8 + 2 + 1 = 139_{10}$$

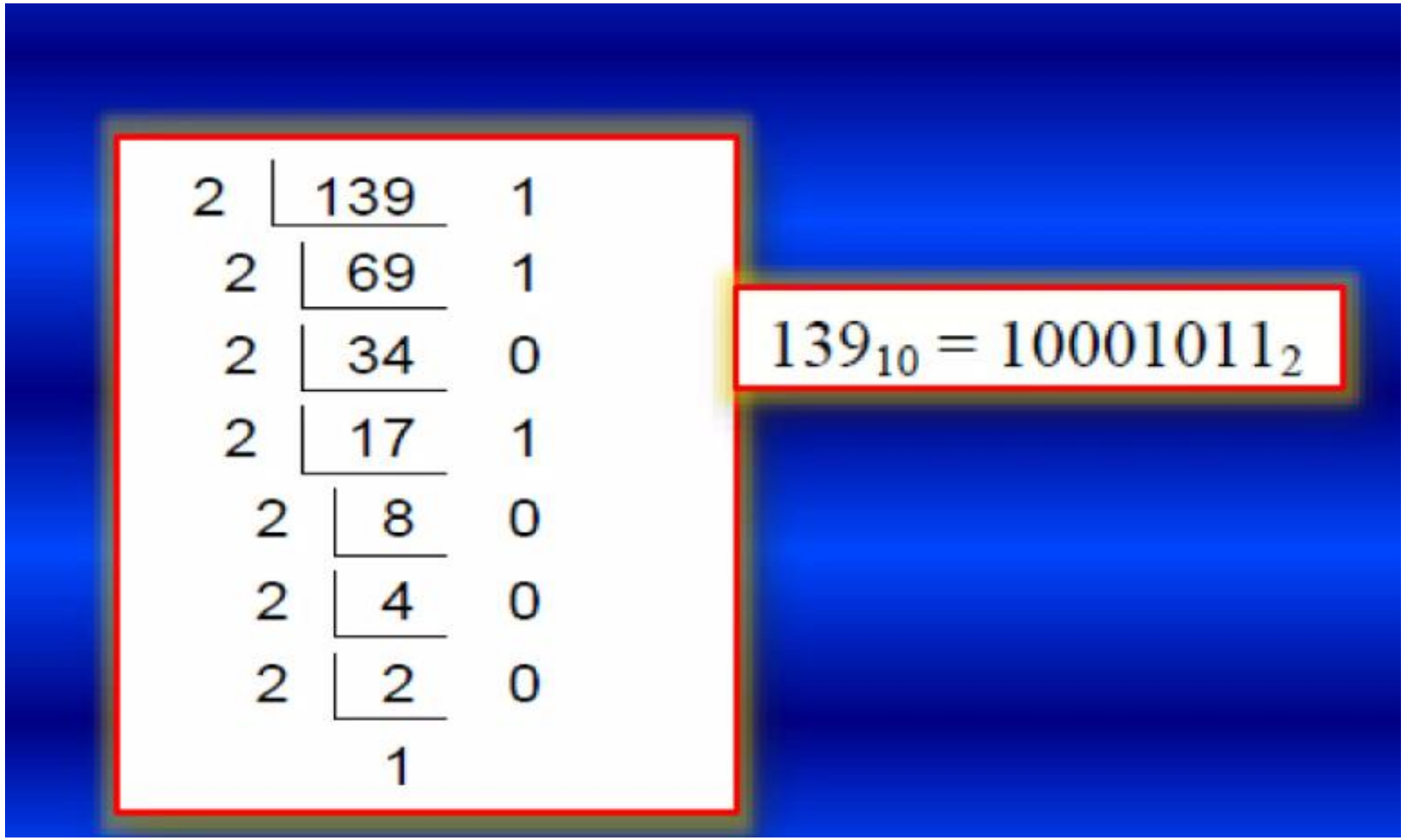
EXAMPLE


The value of binary 01100001 is decimal 105. This is worked out below:
0 1 1 0 1 0 0 1
0 X 128
1 X 64
1 X 32
0 X 16
1 X 8
0 X 4
0 X 2
1 X 1
= 1
= 0
= 0
= 8
= 0
= 32
= 64
= 0
Answer: 105

DECIMAL NUMBER

- The numbers that we are used to seeing are called decimal numbers.
- Decimal numbers consist of the digits from 0 (zero) through 9. S = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}
- Another name for decimal numbers are base-10 (pronounced "base ten") numbers.

DECIMAL TO BINARY

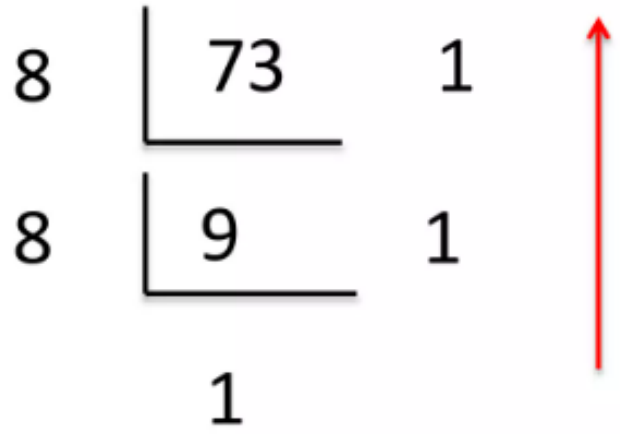


OCTAL NUMBERS

- Octal digits have place values based on the value 8.
- The octal numbering system includes eight base digits (0, 1, 2, 3, 4, 5, 6, 7)
- Computer scientists are often looking for shortcuts to do things.
- One of the ways in which we can represent binary numbers is to use their octal equivalents instead.
- This is especially helpful when we have to do fairly complicated tasks using numbers.

CONVERSION OF OCTAL TO BINARY

- **Example: convert the number 111,base 10 to octal.**



$73_{10} = 111_8$

HEXA DECIMAL NUMBER SYSTEM

Characteristics

- A positional number system
- Has total 16 symbols or digits (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F). Hence its base = 16
- The symbols A, B, C, D, E and F represent the decimal values 10, 11, 12, 13, 14 and 15 respectively
- The maximum value of a single digit is 15 (one less than the value of the base)

Hexadecimal to Binary Conversion

- **Hexadecimal-to-Decimal Conversion**
- One way to find the decimal equivalent of a hexadecimal number is to first convert the hexadecimal number to binary and then convert from binary to decimal.
- Convert the hexadecimal number 1C to decimal:
- 1 C
- 0001 1100 $= 2\square + 2^3 + 2^2 = 16 + 8 + 4 = 28$

Binary to Hexadecimal Conversion

- Simply break the binary number into 4-bit groups, starting at the right-most bit and replace each 4-bit group with the equivalent hexadecimal symbol as in the following example.
- Convert the binary number to hexadecimal:
- 1100101001010111
- Solution:
- 1100 1010 0101 0111
- C A 5 7 = CA57


Thank you