Sétif 1 University
Faculty of Sciences
Common Core Mathematics and Computer Science

1st semester (year 2025/26)
Machine Structures 1 course
Kara Abdelaziz professor

# Problem set 2
# (Number System)

## Exercise 1:

Perform the following conversions, showing all steps involved in the calculation:

**1. Decimal to Binary:**
Convert $(25)_{10}$ to binary.
Convert $(100)_{10}$ to binary.
Convert $(153)_{10}$ to binary.

**2. Binary to Decimal:**
Convert $(11011)_{2}$ to decimal.
Convert $(1000101)_{2}$ to decimal.
Convert $(11111111)_{2}$ to decimal.

**3. Decimal to Octal:**
Convert $(45)_{10}$ to octal.
Convert $(212)_{10}$ to octal.

**4. Octal to Decimal:**
Convert $(63)_{8}$ to decimal.
Convert $(307)_{8}$ to decimal.

**5. Decimal to Hexadecimal:**
Convert $(30)_{10}$ to hexadecimal.
Convert $(4096)_{10}$ to hexadecimal.

**6. Hexadecimal to Decimal:**
Convert $(1A)_{16}$ to decimal.
Convert $(C3D)_{16}$ to decimal.

**7. Binary to Octal/Hexadecimal:**
Convert $(101101010)_{2}$ to octal.
Convert $(11100101100)_{2}$ to hexa.

**8. Octal/Hexadecimal to Binary:**
Convert $(725)_{8}$ to binary.
Convert $(A5B)_{16}$ to binary.

**9. Octal to Hexadecimal:**
Convert $(724)_{8}$ to hexadecimal.
Convert $(3051)_{8}$ to hexadecimal.

**10. Hexadecimal to Octal:**
Convert $(A6)_{16}$ to octal.
Convert $(1D3)_{16}$ to octal.

## Exercise 2:

The Babylonians developed the sexagesimal (base 60) number system about 4000 years ago. It heritage is still noticed in our modern society when using clocks, in the form of 60 seconds representing 1 minute, and 60 minutes representing one hour.

1. How do you write the number $4000_{10}$ in sexagesimal?
2. How many hours:minutes:seconds elapse in 4000 seconds?

## Exercise 3:

1. Determine the unknown base $x$ solving to the following equation $(101)_x = (26)_{10}$
2. Once $x$ is found, convert the number $(142)_x$ to Decimal, Binary, and Hexadecimal.
3. Convert the decimal number $(205)_{10}$ to base $x$.

## Exercise 4:

Perform the following conversions, showing all steps involved in the calculation:

**1. Decimal Fraction to Binary Fraction:**
Convert $(0.75)_{10}$ to binary fraction.
Convert $(0.125)_{10}$ to binary fraction.
Convert $(12.8125)_{10}$ to binary.

**2. Binary Fraction to Decimal Fraction:**
Convert $(0.11)_2$ to decimal fraction.
Convert $(0.0101)_2$ to decimal fraction.
Convert $(1101.1011)_2$ to decimal.

**3. Decimal Fraction to Octal Fraction:**
Convert $(0.5)_{10}$ to octal fraction.
Convert $(87.25)_{10}$ to octal.

**4. Octal Fraction to Decimal Fraction:**
Convert $(0.4)_8$ to decimal fraction.
Convert $(156.12)_8$ to decimal.

**5. Decimal Fraction to Hexadecimal:**
Convert $(0.5)_{10}$ to hexadecimal .
Convert $(257.0625)_{10}$ to hexadecimal.

**6. Hexadecimal Fraction to Decimal:**
Convert $(0.8)_{16}$ to decimal fraction.
Convert $(D5.1C)_{16}$ to decimal.

## Exercise 5:

Perform the following conversions, showing all steps involved in the calculation:

**1. Binary Addition:**
$(1011)_2 + (0010)_2$
$(1110)_2 + (0101)_2$
$(100.11)_2 + (110.1)_2$

**2. Binary Subtraction:**
$(1101)_2 - (0100)_2$
$(1000)_2 + (-0011)_2$
$(0100)_2 - (1011)_2$
$(10.110)_2 - (10.1)_2$

**3. Binary Multiplication:**
$(101)_2 \times (10)_2$
$(110)_2 \times (11)_2$
$(10.11)_2 \times (-10.1)_2$

**4. Binary Division:**
$(1010)_2 \div (10)_2$
$(11001)_2 \div (101)_2$
$(-111.001)_2 \div (1.10)_2$

Perform on the fly (directly) the following conversions, without calculation:

**6. Binary Multiplication:**
$(1011)_2 \times 2^2$
$(110)_2 \times (1000)_2$
$(1100.101)_2 \times 2^4$

**7. Binary Multiplication:**
$(11000)_2 \div 2^3$
$(10111)_2 \div (1000)_2$
$(110100.101)_2 \div 2^4$

**1.** Conclude from the conversions 6 and 7 the formula of: number = $2^n$ , then generalize the formula for any base.

**2.** From the conversions 6 and 7, deduce the effect of multiplying and dividing by the power of 2, then generalize this deduction for any base.