Q1) Explain Binary Addition and Subtraction with rules and examples.

Answer:

Binary arithmetic is mathematical operation performed on binary numbers.

Binary Addition Rules:

0 + 0 = 0
0 + 1 = 1
1 + 0 = 1
1 + 1 = 0 (carry 1)

Example:

1011 + 0101

------ 10000

Binary Subtraction Rules:

1 − 1 = 0
1 − 0 = 1
0 − 0 = 0
0 − 1 = 1 (borrow 1)

Example:

1010 - 0011

------ 0111

Binary addition and subtraction are performed inside ALU.

Q2) Explain Binary Multiplication Algorithm with example.

Answer:

Binary multiplication is based on:

0 × anything = 0
1 × anything = same number

It is performed using **shift-and-add algorithm**.

Example: Multiply 110 × 101

```
   110
 × 101
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   110      (1 × 110)
  000       (0 × 110 shifted left)
+ 110        (1 × 110 shifted twice)
--------------
 11110
```

Final result = **11110_2**

Q3) Explain Binary Division Algorithm with example.

Answer:

Binary division works like decimal division —
Repeated subtraction + shifting.

Example:
$1101_2 \div 10_2$ (13 ÷ 2)

Outcome:
Quotient = 110_2
Remainder = 1

Division in processors uses **Restoring/Non-Restoring division algorithms**.

Q4) Explain Floating Point Number Representation and Arithmetic.

Answer:

Floating point format stores **real/fractional numbers**.

General representation:

Number = Mantissa × Base^Exponent

Mantissa holds significant bits
Exponent defines scaling

Example:
1.101×2^3

Floating point operations include:

- Exponent alignment
- Addition/subtraction
- Normalization

Used in scientific computing, graphics, physics simulations.

Q5) What is Decimal Arithmetic Unit? Explain.

Answer:

Decimal arithmetic is performed on **decimal digits**, mainly using BCD (Binary Coded Decimal).

Decimal arithmetic unit performs:

Decimal Addition
Decimal Subtraction
Decimal Multiplication
Decimal Division

Used in accounting, finance, calculators and business apps.

Q6) Explain Half-Adder and Full-Adder with functions.

Answer:

Half-Adder

Performs addition of two 1-bit numbers
Inputs: A, B

• Sum = A XOR B
• Carry = A AND B

Full-Adder

Adds three bits (A, B, Carry-in)
Outputs: Sum, Carry

• Sum = A XOR B XOR Cin
• Carry = AB + Cin(A XOR B)

➡ Both circuits are part of ALU.

Rules of Binary Arithmetic

Binary arithmetic 0 aur 1 par based hota hai. Basic rules:

Addition Rules:

0 + 0 = 0
0 + 1 = 1
1 + 0 = 1
1 + 1 = 0 (carry 1)

Subtraction Rules:

0 − 0 = 0
1 − 0 = 1
1 − 1 = 0
0 − 1 = 1 (borrow 1)

Multiplication Rules:

0 × 0 = 0
0 × 1 = 0
1 × 0 = 0
1 × 1 = 1

Division Rules:

0 ÷ 1 = 0
1 ÷ 1 = 1
1 ÷ 0 = undefined (not possible)

Perform binary subtraction: 1011 − 0010

1011 - 0010

------ 1001

Answer = **1001_2**

Define Floating Point Representation

Floating-point representation fractional numbers ko represent karne ka binary format hai.

Iska form hota hai:

N = Mantissa × 2^Exponent

Isse large aur small decimal values store ki ja sakti hai.

Explain concept of BCD

BCD (Binary Coded Decimal) ek technique hai jisme **har decimal digit 4 bits me represent hoti hai.**

Example:

5 = 0101

9 = 1001

Iska use calculator, digital clocks, and financial systems me hota hai.

Differentiate Half Adder & Full Adder

Half Adder	Full Adder
2 inputs: A, B	3 inputs: A, B, Carry-in
Sum & Carry generate karta hai	Sum & Carry-out generate karta hai
Previous carry handle nahi karta	Previous carry process karta hai

Explain Shift-and-Add Multiplication

Binary multiplication ko repeated shifting & adding se perform kiya jata hai.
Steps:

1. LSB check karo.
2. Agar bit 1 hai toh multiplicand add karo.
3. Result ko left shift karo.
4. Next bit process karo.
   Ye CPU multipliers me use hota hai.

What is decimal arithmetic?

Decimal arithmetic normal base-10 number system me operations perform karta hai — 0–9 digits ke sath addition, subtraction, multiplication, division.

Short answers

What is binary arithmetic?

Arithmetic operations using base-2 number system (0 & 1).

What are addition rules?

Binary addition ke rules:
0+0=0, 0+1=1, 1+0=1, 1+1=0 with carry 1.

What is a floating-point number?

Fractional value jisko mantissa aur exponent ke form me represent kiya jata hai.

Write floating point formula.

N = Mantissa × Base^Exponent

Binary me Base = 2 hota hai.

Write binary of 1 ÷ 0

Undefined (division by zero is not possible)

What is decimal arithmetic unit?

Processor ka woh part jo base-10 operations perform karta hai — jaise calculator circuits.

Write sum & carry expression for half adder.

Sum = A ⊕ B

Carry = A · B

Full adder sum formula kya hota hai?

Sum = A ⊕ B ⊕ Cin

Carry formula (extra info):
Cout = AB + BCin + ACin

MCQ TYPE QUESTIONS

1 + 1 = ? → 0 (carry 1)
1 × 101 = 101
Floating point = Mantissa × Base^Exponent
Half-adder carry = A · B
Full adder sum = A ⊕ B ⊕ Cin