Assignment 1: (Base 6) Numbering System Creation

Problem Statement: Create a base 6 numbering system

Objectives:

- Define a base 14 numbering system
- List down two digit numbers
- Demo : Single digit addition and Subtraction
- Demo : Double digit addition and Subtraction
- Demo : Write table BxB
- Demo : multiplication for single digit
- Demo : multiplication for double digit
- Translate : Base 10 to Base 6 (and vice versa)

Demo 1:

Base 6 number system will be based on below symbols:

0, 1, 2, 3, 4, 5

Demo 2:

Two digit number rows are

10 11 12 13 14 15

20 21 22 23 24 25

30 31 32 33 34 35

40 41 42 43 44 45

50 51 52 53 54 55

Demo 3: Single digit addition and Subtraction

Single Digit Addition Example:

a) 2 + 3=5

b) 4 + 2 = 10 (base-6)

c) 5 + 5 = 14 (base-6)

If the sum is 6 or greater, it would carry the value to the next higher place value

Single Digit Subtraction Example:

a) 5 - 2 = 3

b) 3 - 1 = 2

Demo 4:- Double digit addition and Subtraction

Double Digit Addition Example: a)$23_6 + 14_6 = 41_6$

Add rightmost digits (3 + 4):3 + 4 = 7 → 7 in base-6 is 1 carry 1 (since 7 = 6 + 1 → write 1, carry 1)

Add leftmost digits with carry (2 + 1 + 1):2 + 1 + 1 = 4 → valid in base-6

b) $45_6 + 32_6 = 121_6$

Double Digit Subtraction Example:

a) $41_6 - 14_6 = 23_6$

Rightmost digits (1 - 4):Not possible → borrow 1 from left digit.Left digit becomes 4 - 1 = 3

Borrow adds 6 to right: 1 + 6 = 7. 7 - 4 = 3

Left digit: 3 - 1 = 2

Final answer: 23

b) $52_6 - 35_6 = 13_6$

Demo 5: Multiplication table

x	**1**	**2**	**3**	**4**	**5**
1	1	2	3	4	5
2	2	4	10	12	14
3	3	10	13	20	23
4	4	12	20	24	32
5	5	14	23	32	41

Demo 6: Single digit multiplication

Example 1: 2 × 3

- In decimal: 2 × 3 = 6
- Convert 6 to base-6 → 6 ÷ 6 = 1 remainder 0
  $2 \times 3 = 10_6$

Example 2: 4 × 2

- In decimal: 4 × 2 = 8
- Convert to base-6:
  - 8 ÷ 6 = 1 remainder 2 → 12 in base-6

  $4 \times 2 = 12_6$

Example 3: 5 × 5

- Decimal: 5 × 5 = 25
- Convert 25 to base-6:

  25 ÷ 6 = 4 remainder 1 → 41_6
  $5 \times 5 = 41_6$

Demo 7: Multiplication double digit

Example 1: $12_6 \times 14_6$

Step 1: Convert to decimal

- $12_6 = 1\times6 + 2 = 8$
- $14_6 = 1\times6 + 4 = 10$

Step 2: Multiply in decimal

- $8 \times 10 = 80$

Step 3: Convert 80 to base-6

- $80 \div 6 = 13$ remainder 2 →
- $13 \div 6 = 2$ remainder 1 →
- $2 \div 6 = 0$ remainder 2

So in base-6:
$12_6 \times 14_6 = 2\ 1\ 2$ (base-6) → 212_6

Demo 8: Conversion from decimal to base 6 and vice versa

Part 1: Base-6 ➞ Base-10 (Senary to Decimal)

Multiply each digit by powers of 6, starting from the right

Example 1: $231_6 \rightarrow ?_{10}$

$= 2\times6^2 + 3\times6^1 + 1\times6^o$

$= 2\times36 + 3\times6 + 1\times1$

$= 72 + 18 + 1$

$= 91_{10}$

$231_6 = 91_{10}$

Example 2: $54_6 \rightarrow ?_{10}$

$= 5\times6^1 + 4\times6^o$

$= 5\times6 + 4 = 30 + 4$

$= 34_{10}$

$54_6 = 34_{10}$

Part 2: Base-10 ➞ Base-6 (Decimal to Senary)

Use division by 6 and record remainders in reverse.

Example 1: $91_{10} \rightarrow ?_6$

Divide by 6 repeatedly:

91 ÷ 6 = 15 R1

15 ÷ 6 = 2 R3

2 ÷ 6 = 0 R2

→ Read remainders in reverse: 2 3 1

$91_{10} = 231_6$

Example 2: $38_{10} \rightarrow ?_6$

38 ÷ 6 = 6 R2

6 ÷ 6 = 1 R0

1 ÷ 6 = 0 R1

→ 1 0 2

$38_{10} = 102_6$