**Practical No. 11**

**Title:** Addition and Subtraction of Two 16-bit Numbers (Sum 16-bit)

**Objective:** To perform the addition and subtraction of two 16-bit numbers and obtain a 16-bit result using a microprocessor/microcontroller.

**Theory:** In a microprocessor, 16-bit addition and subtraction are performed using **register pairs** because most microprocessors process 8-bit data at a time.

**Addition of Two 16-bit Numbers:**

* 16-bit numbers are stored in two consecutive 8-bit memory locations or register pairs.
* The **lower byte** is added first, followed by the **higher byte** with the carry (if any).
* The final result is a 16-bit sum.

**Subtraction of Two 16-bit Numbers:**

* The **2’s complement** method is used for subtraction.
* The **lower byte** is subtracted first, followed by the **higher byte**, considering borrow (if any).
* If the result is negative, it is stored in **2’s complement form**.

**Example (16-bit Addition & Subtraction):**

**Given Numbers (Hexadecimal):**

A = 1A2F (6695 in decimal)

B = 0B45 (2885 in decimal)

**Addition:**

1A2F

+ 0B45

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2574 (Final sum)

**Subtraction:**

1A2F

- 0B45

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0ED6 (Final difference)

If **A < B**, the result is stored in **2’s complement form**.

**Materials/Tools Required:**

* Microprocessor/microcontroller (e.g., 8085/8051)
* Assembler/Simulator
* Computer system with programming software
* Binary calculator (optional)

**Procedure:**

**For Addition:**

1. **Initialize Registers:**
   * Load the lower byte of the first 16-bit number into a register (e.g., L register).
   * Load the higher byte into another register (e.g., H register).
2. **Load the Second Number:**
   * Store the second number in another register pair (D, E registers).
3. **Perform Addition:**
   * Add the lower bytes (L + E).
   * Add the higher bytes (H + D) along with the Carry Flag (if any).
4. **Store the Result:**
   * Store the 16-bit sum in memory.

**For Subtraction:**

1. **Load the First 16-bit Number:**
   * Store it in the HL register pair.
2. **Load the Second 16-bit Number:**
   * Store it in the DE register pair.
3. **Perform Subtraction:**
   * Subtract the lower bytes (L - E).
   * Subtract the higher bytes (H - D) with the Borrow Flag (if any).
4. **Store the Result:**
   * Store the 16-bit difference in memory.

**Observations:**

* Addition results in a correct 16-bit sum unless an **overflow occurs**.
* Subtraction using **2’s complement** handles both positive and negative results.
* The **Carry Flag (CY)** is checked for overflow in addition.
* The **Borrow Flag** determines if the result is negative in subtraction.

**Conclusion:**

The addition and subtraction of two 16-bit numbers are successfully performed using register pairs. The operations are handled with carry and borrow mechanisms, ensuring accuracy in multi-byte arithmetic.

**Applications:**

* Used in microprocessor arithmetic computations, such as memory address calculations.
* Essential in financial and scientific computing for handling large numbers.
* Applied in embedded systems for sensor data processing and measurement calculations.