**Lab Session 09**

**Objective**

The main objective of this lab is to learn how to add and subtract signed number in signed and magnitude, 1’s and 2’s complements.

**Theory:**

**Task 1: Signed and Magnitude System**

Note that subtraction is the same as addition with negative number. A process of addition in signed and magnitude is as follows:

1. Convert the two numbers to signed and magnitude.
2. If the two numbers have the same sign, find the sum of the magnitudes and keep the sign bit.
3. If the two numbers have the different signs, find the difference of the magnitudes and keep the sign of the larger magnitude.

Activity 1.1: Perform the following operation in signed and magnitude in 8 bits: 17 + 35

|  |  |
| --- | --- |
| +17 = 11h = 00010001  +35 = 23h = 00100011  Addition of Both:  00010001  00100011  --------  00110100 = 34h = +52 |  |

Activity 1.2: Perform the following operation in signed and magnitude in 8 bits: −17 + 35

|  |  |
| --- | --- |
| -17 = EFh = 11101111  +35 = 23h = 00100011  Difference of Both:  11101111  00100011  --------  00010010 = 12h = +12 |  |

Activity 1.3: Perform the following operation in signed and magnitude in 8 bits: −23 − 44

|  |  |
| --- | --- |
| -23 = E9h = 11101001  -44 = D4h = 00101100  Addition of Both:  11101001  00101100  --------  10111101 = BDH = -66 |  |

**Task 2: 1’s Complement**

A process of addition in 1’s complement is as follows:

1. Convert the two numbers to 1’s complement.
2. Perform addition.
3. If there is a carry out, add one to the sum.

Activity 2.1: Perform the following operation in 1’s complement in 8 bits: 17 + 35

|  |  |
| --- | --- |
| 17 WITH 1’S COM = 00010001  35 WITH 1’S COM = 00100011  Addition of Both:  00010001  00100011  --------  00110100 = 34H = 52 |  |

**Activity 2.2:** Perform the following operation in 1’s complementin 8 bits: **−17 + 35**

|  |  |
| --- | --- |
| -17 WITH 1’S COM = 11101110  35 WITH 1’S COM = 00100011  Addition of Both:  11101110  00100011  --------  00010010 = 12H = 18 |  |

Activity 2.3: Perform the following operation in 1’s complement in 8 bits: −23 − 44

|  |  |
| --- | --- |
| -23 WITH 1’S COM = 11101000  -44 WITH 1’S COM = 11010011  Addition of Both:  11101000  11010011  --------  (1)10111011  1  10111100  1  10111101 = BDH = -67 |  |

**Task 3: 2’s Complement**

A process of addition in 2’s complement is as follows:

1. Convert the two numbers to 2’s complement.
2. Perform addition.

Activity 3.1: Perform the following operation in 2’s complement in 8 bits: 17 + 35

|  |  |
| --- | --- |
| 17 = 00010001  35 = 00100011  Addition of Both:  00010001  00100011  --------  00110100 = 34H = 52 |  |

**Activity 3.2:** Perform the following operation in 2’s complementin 8 bits: **−17 + 35**

|  |  |
| --- | --- |
| 35 = 00100011  17 = 00010001  So -17 = 11101111 = EFH  Addition of Both: |  |

Activity 3.3: Perform the following operation in 2’s complement in 8 bits: −23 − 44

|  |  |
| --- | --- |
| 11101001 | + |
| 11010100 |
| 110111101 |  |
| 10111101 |  |

Activity 3.4: Perform the following operation in 2’s complement in 8 bits:

|  |  |
| --- | --- |
| 10100000 | carry |
| 10101001 | + |
| 10110100 |
| 101011101 |  |
| 01011101 |  |

Activity 3.5: Is the result in Activity 3.4 correct? If the answer is either yes or no, explain why?

No, since Carry in is not the same as carry out.

**Task 4: Hexadecimal System**

A Hexadecimal number is a number with base sixteen.

Activity 4.1: Perform the following operation:

|  |  |
| --- | --- |
| 2A9F6 | + |
| D6B58 |
| 10154E |  |

Activity 4.2: Perform the following operation:

|  |  |
| --- | --- |
| D6B58 | - |
| 2A9F6 |
| AC162 |  |