## (2) Arithmetic Group

- The instruction of this group perform arithmetic operation such as addition, subtraction, increment or decrement of the content of register or memory.
- The instruction of this group perform various arithmetic operation such as

# Arithmetic Group

| Addition | Subtraction | Increment | Decrement |
|---|---|---|---|
| 8-bit | 8-bit | 8-bit | 8-bit |
| ADD r | SUB r | INR r | DCR r |
| ADD M | SUB M | INR M | DCR M |
| ADI data | SUI data | | |
| 8-bit with carry | 8-bit with borrow | 16-bit | 16-bit |
| ADC r | SBB r | INX rp | DCX rp |
| ADC M | SBB M | | |
| ACI data | SBI data | | |
| 8-bit decimal | | | |
| DAA | | | |
| 16-bit | | | |
| DAD rp | | | |

- All flags are affected.

| S.No. | Instruction | Description | No. of Bytes | Addressing Mode | Example Before Execution | Example After Execution |
|---|---|---|---|---|---|---|
| 1. | ADD r<br>[A] ← [A] + [r] | The content of register is added to the content of accumulator & stored in accumulator. | 1 | Register | ADD B<br>[A] = 35H<br>[B] = 77H | [A] = ACH<br>[B] = 77H |
| 2. | ADD M<br>[A] = [A] + [[HL]] | The content of memory location addressed by HL pair is added to the content of ammulator. & stored in accumulator. | 1 | Indirect | HL = 2500H<br>[2500] = 73<br>[A] = 57 | HL = 2500H<br>[2500] = 73<br>[A] = CA H |

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| 3. | ADI data<br>[A] ← [A] + data | The data is added to content of accumulator. The result is stored in accumulator. | 2 | Immediate | ADI 67<br>[A] = 59H<br>[A] = 59+67 = C0 H |
| 4. | ADC r<br>[A] ← [A] + [r] + [CY] | The content of register & carry flag status are added to the content of accumulator & result is stored in accumulator | 1 | Register | ADC B<br>[A] = 57H<br>[B] = 63H<br>[CY] = 1<br>[A] = 57+63 H = BB H<br>[B] = 63 H<br>CY = 0 |
| 5. | ADC M<br>[A] ← [A] + [[HL]] + [CY] | The content of memory location addressed by HL pair & CY flag are added to accumulator. | 1 | Indirect | ADC M<br>[A] = AB H<br>[CY] = 1<br>HL = 2500H<br>[2500] = CDH<br>[A] = AB+CD+1 = 79 H<br>HL = 2500 H<br>[2500] = CD H |
| 6. | ACI data<br>[A] ← [A] + data + [CY] | The data & carry flag are added to the accumulator. | 2 | Immediate | ACI 77<br>[A] = A2 H<br>[CY] = 1<br>[A] = A2+77+1 = 1B<br>[CY] = 1 |
| 7. | DAD rp<br>[HL] ← [HL] + [rp] | The content of register pair are added to the content of HL pair. | 1 | Register | DAD D<br>[HL] = ABC9<br>[DE] = 7890<br>[HL] = 2459H |
| 8. | SUB r<br>[A] ← [A] - [r] | The content of register r is subtracted from content of accumulator. | 1 | Register | SUB B<br>[A] = 12 H<br>[B] = 34 H<br>[A] = DE H<br>[B] = 34 H |
| 9. | SUB M<br>[A] ← [A] - [[HL]] | The content of memory location addressed by HL pair is subtracted from content of accumulator. | 1 | Indirect | SUB M<br>[HL] = 4500H<br>[4500] = 78H<br>[A] = AB H<br>[HL] = 4500H<br>[4500] = 78H<br>[A] = AB-78 = 33 H |
| 0. | SUI data<br>[A] ← [A] - data | The data is subtracted from the content of accumulator. | 2 | Immediate | SUI 77<br>[A] = FE H<br>[A] = FE-77 = 87 H |

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|---|---|---|---|---|---|---|
| 11. | SBB r<br>[A] ← [A] - [r] - [CY] | The content of register & carry flag are subtracted from the content of accumulator. | 1 | Register | SBB C<br>[A] = 78H<br>[C] = 39H<br>CY = 1 | [A] = 38H<br>[C] = 39H<br>CY = 1 |
| 12. | SBB M<br>[A] ← [A] - [[HL]] - [CY] | The content of memory location by HL pair and carry flag are subtracted from the content of accumulator. | 1 | Indirect | SBB M<br>[HL] = 7500H<br>[7500] = 67H<br>[A] = 34H<br>[CY] = 1 | [HL] = 7500H<br>[7500] = 67H<br>[A] = 34 - 67 - 1<br>= CCH |
| 13. | SBI data<br>[A] ← [A] - data - [CY] | The data & carry flag is subtracted from the content of accumulator. | 2 | Immediate | SBI 77<br>[A] = ABH<br>[CY] = 0 | [A] = AB - 77<br>= 34H |
| 14. | INR r<br>[r] ← [r] + 1 | The content of register is incremented by one. | 1 | Register | INR B<br>[B] = FFH | = 00H<br>[B] = FF + 1 |
| 15. | INR M<br>[HL] ← [HL] + 1 | The content of memory location addressed by HL pair is ↑ment by 1 | 1 | Indirect | INR M<br>[HL] = 7500H<br>[7500] = 78H | [HL] = 7500H<br>[7500] = 79H |
| 16. | INX rp<br>[rp] ← [rp] + 1 | The content of register pair rp is incremented by one. | 1 | Register | INX H<br>[HL] = FFFFH | [HL] = FFFF + 1<br>= 0000H |
| 17. | DCR r<br>[r] ← [r] - 1 | The content of register r is decremented by one. | 1 | Register | DCR B<br>[B] = 00H | [B] = 00 - 1<br>= FFH |
| 18. | DCR M<br>[HL] ← [HL] - 1 | The content of memory location addressed by HL pair is decrement by one. | 1 | Indirect | DCR M<br>[HL] = 7500H<br>[7500] = 79H | [HL] = 7500H<br>[7500] = 78H |
| 19. | DCX rp<br>[rp] ← [rp] - 1 | The content of register pair rp is decremented by one. | 1 | Register | BC = 0000H | BC = 0000 - 1<br>= FFFFH |
| 20. | DAA<br>Decimal Adjust Accumulator | It converts the Hex result in accumulator into decimal or BCD.<br>It is used after ADD, ADI, ACI, ADC.<br>→ If value of 4 LSB of A79 or AC=1, 06 is added to accumulator.<br>→ If the value of 4 MSB of A79 or CY=1 60 is added to accumulator. | 1 | Implicit | ADD B<br>DAA<br>[A] = 27H<br>[B] = 46H | [A] = 27 + 46<br>= 6D + 06<br>= 73H<br>[B] = 46H |