

## Unit-6(Hmetic circuit)

### \*\*Adder:-

→ There are two types of adder.

(1) Half adder

(2) Full adder

### **\*\* Half adder:-**

→ it adds two single bit binary numbers.

Block diagram of half adder:-

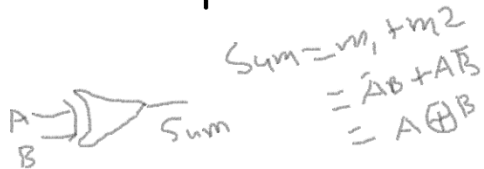
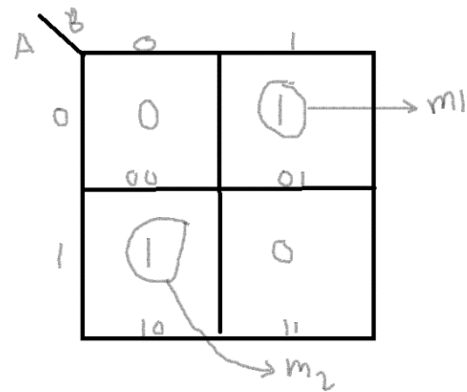


### **Truth table of half adder:-**

A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

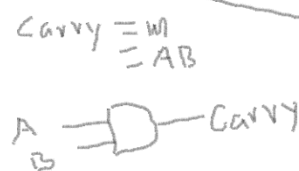
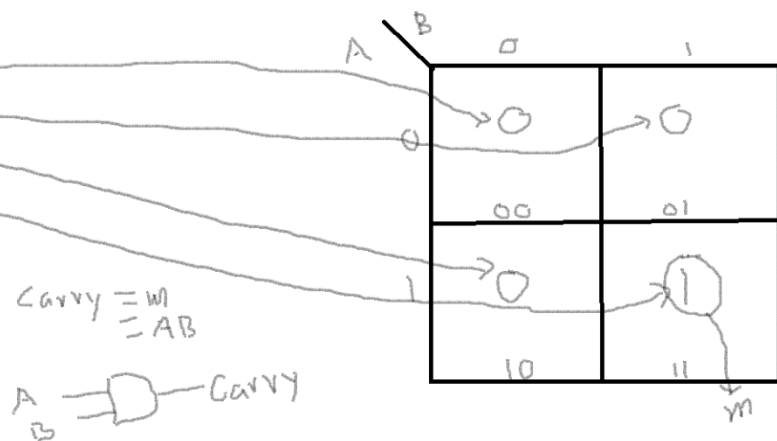
### K-Map for sum:-

A	B	Sum
0	0	0
0	1	1
1	0	1
1	1	0

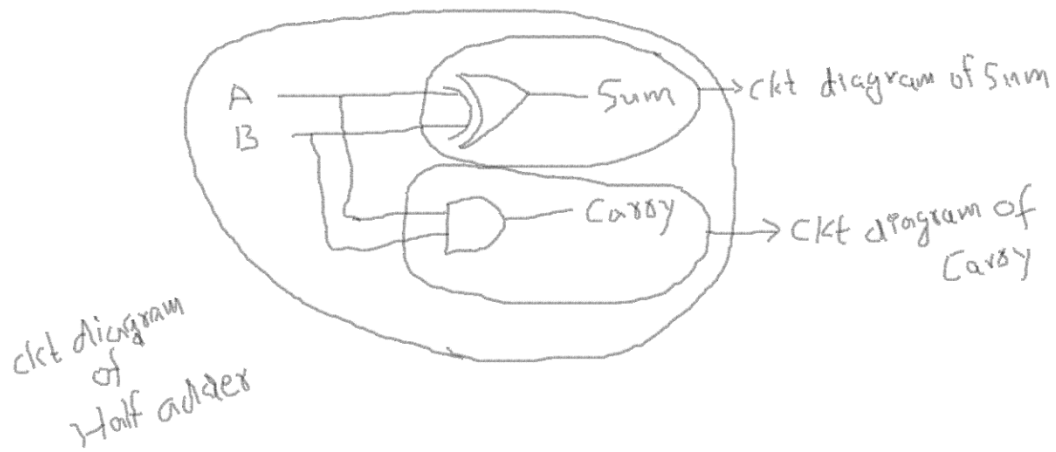


### K-Map for Carry:-

A	B	Carry
0	0	0
0	1	0
1	0	0
1	1	1



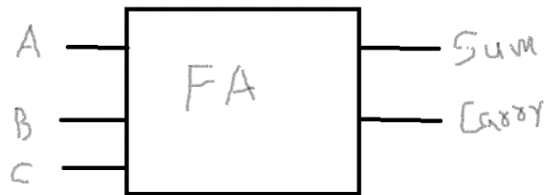
Circuit diagram of half adder = circuit diagram of Sum + circuit diagram of carry.



## \*\* Full Adder:-

→ it adds three single bit binary numbers

**Block diagram of full adder.**



### Truth table of full adder:-

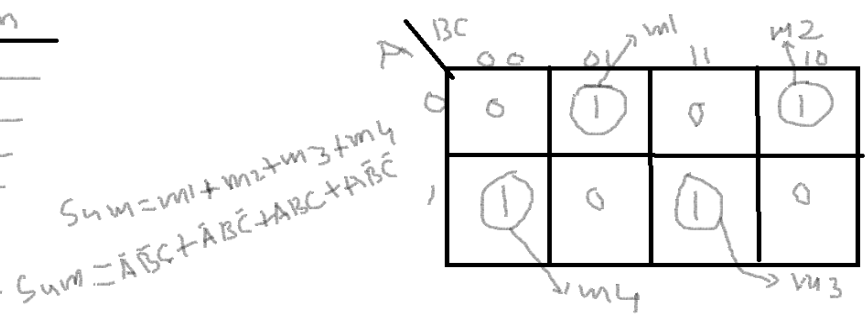
A	B	C	Sum	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Note:-  $1 + 1 = 0$  & carry = 1

$1 + 1 + 1 = 1$  & carry = 1

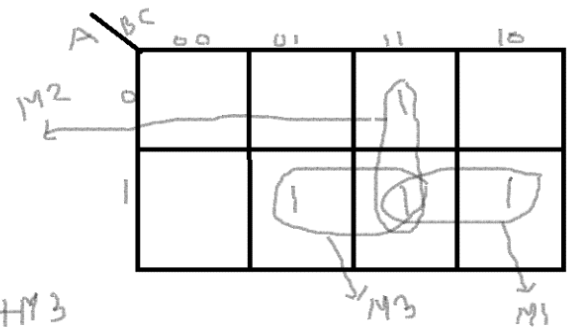
### K-Map for Sum:-

A	B	C	Sum
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1



### K-map for Carry:-

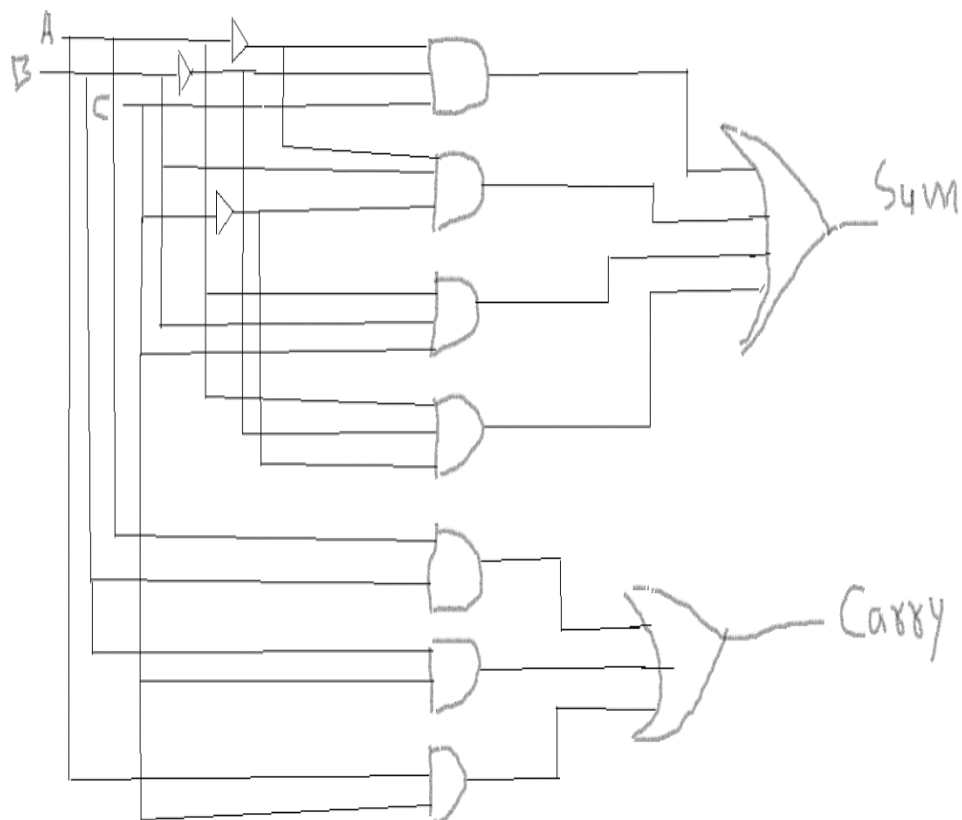
A	B	C	Carry
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1



$$\text{Carry} = M_1 + M_2 + M_3$$

$$= AB + BC + AC$$

### Circuit diagram of full adder:-



### \*\*Subtractor :-

→ Subtractor subtracts binary numbers. There are two types of Subtractor.

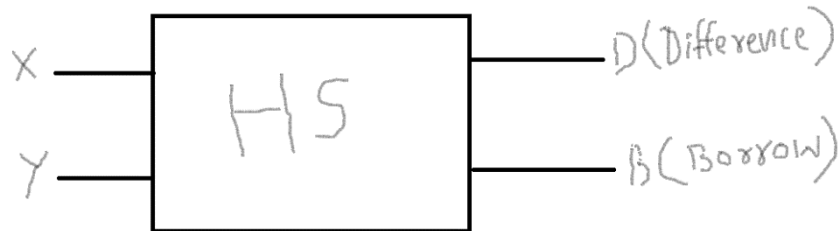
- (1) Half Subtractor
- (2) Full Subtractor.

## \*\* Half Subtractor:-

→ It Subtracts two single bit binary numbers.

Block diagram of half Subtractor:-

→ it has two inputs and two outputs (difference & borrow).



## Truth table of Half Subtractor:-

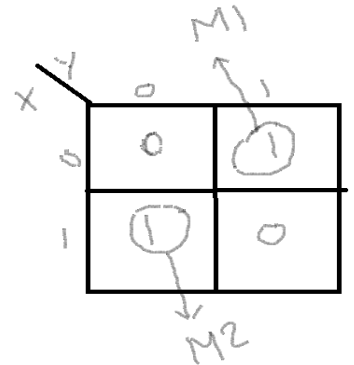
X	Y	Difference	Borrow
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

### K-Map for Difference:-

X	Y	D
0	0	0
0	1	1
1	0	1
1	1	0

$$D = M_1 + M_2$$

$$= \bar{X}Y + X\bar{Y}$$

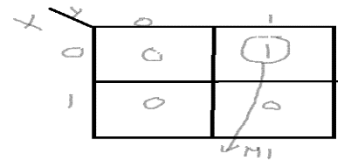


### K-Map for Borrow:-

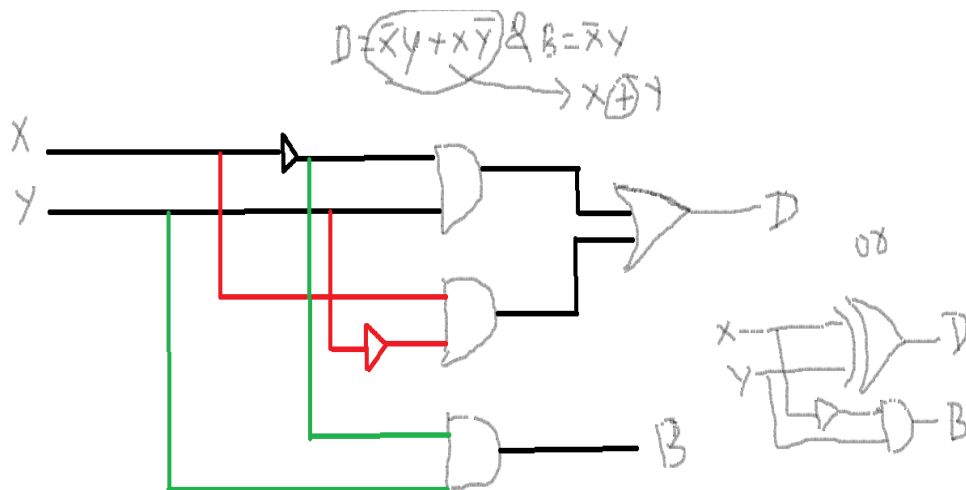
X	Y	B
0	0	0
0	1	1
1	0	0
1	1	0

$$B = M_1$$

$$= \bar{X}Y$$



### Logic circuit of Half :-

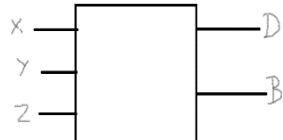


## \*\* Full Subtractor:-

→ It performs subtraction of 3 bits binary numbers.

→ there is 3 inputs & 2 outputs(Difference & Borrow) .

### Block diagram of Full Subtractor:-



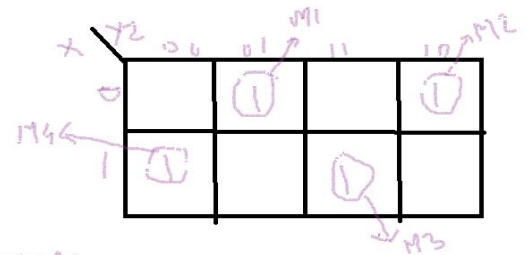
### Truth table of Full Subtractor:-

A	B	C	Difference	Borrow
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1



### K-Map for Difference:-

X	Y	Z	D
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1



$$D = M_1 + M_2 + M_3 + M_4$$

$$= \bar{x}\bar{y}z + \bar{x}y\bar{z} + x\bar{y}z + x\bar{y}\bar{z}$$

### K-Map for Borrow:-

X	Y	Z	B
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1



$$B = M_1 + M_2 + M_3$$

$$= \bar{x}y + \bar{x}z + yz$$

**Logic circuit for Full Subtractor:-**

$$D = \bar{X}Yz + \bar{X}Y\bar{z} + X\bar{Y}z + XYz, B = \bar{X}Y + \bar{X}z + Yz$$

