BITWISE OPERATORS

- OPERATORS-

1. AND (&)

a	b	a & b
0	0	0
0	1	0
1	0	0
1	1	1

★ When you & 1 with any number, digit remains the same.

```
  1 1 0 0 1 0 1 0 0
& 1 1 1 1 1 1 1 1 1
-----------------
  1 1 0 0 1 0 1 0 0
```

2. OR (|)

a	b	a | b
0	0	0
0	1	1
1	0	1
1	1	1

3. XOR (^) (if and only if)

Exclusive OR

a	b	a ^ b
0	0	0
0	1	1
1	0	1
1	1	0

★ OBSERVATIONS

$a \wedge 1 = \bar{a}$

$a \wedge 0 = a$

$a \wedge a = 0$

4. Complement (~)

$a = 10110$

$\overline{a} = 01001$

5. left shift (<<)

$(10)_{10} = (1010)_2$

$10 << 1$ $\quad$ $1010 << 1 = 10100$

$(20)_{10}$

★ $a << b = a * 2^b$

6. Right shift (>>)

$00110\underline{01} >> 1 = 00110$

★ $a >> b = \frac{a}{2^b}$

- RANGE OF NUMBERS

1. 1 byte

0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1

128

Sign of number

Total = 2 * 2 * ... (8 times)

$= 2^8$

$= 256$

actual number is stored in bits = n-1

∴ 1byte = (8-1) bits = 7 bits

$= 2^7 = 128$

-128 to 127

- Range Formula -

$$-2^{n-1} \text{ to } 2^{n-1} - 1$$

- NUMBER SYSTEMS

1. Decimal - 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 (Base 10)
2. Binary - 0 & 1 (Base 2)
3. Octal - 0, 1, 2, 3, 4, 5, 6, 7 (Base 8)
4. Hexadecimal - 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F (Base 16)

- Conversion

- Decimal to base b

$(17)_{10}$ to 2

2	17	
2	8	1
2	4	0
2	2	0
	1	0

$(10001)_2 = (17)_{10}$

$(17)_{10}$ to 8

8	17	
	2	1

$(21)_8 = (17)_{10}$

- base b to decimal

$(10001)_2 = (?)_{10}$

$1*2^4 + 0*2^3 + 0*2^2 + 0*2^1 + 1*2^0$

$16 + 0 + 0 + 0 + 1$

$(17)_{10}$