Lecture Seven **:The basic rules and identities of Boolean algebra :**

 **a-** x.0=0 **b-** x+0=x **c-** x.1=x **d-** x+1=1

 **e-** x.x=x **f-** x+x=x **g-**  x.x =0 **h-**  x+x=1

 **i-**  x=x

 **2-Commutative laws :**

 **a-** x.y=y.x

 **b-** x+y=y+x

 **3-Associative laws :**

 **a-** (x+y)+z = x+(y+z) = x+y+z

 **b-** (x.y).z = x.(y.z) = x.y.z

 **4-Distributive laws :**

 **a-**  x.(y+z) = (x.y)+(x.z)

 **b-** x+(y.z) = (x+y).(x+Z)

 **5-Absorption laws :**

 **a-** x+x.y = x

 **b-** x+x.y = x+y

 **c-**  x.(x+y) = x

 **6-De Morgan´s theorem :**

 **a-**  x.y = x+y

 **b-** x+y = x.y

 All of these Boolean theorems useful in simplifying a logic expression that is in reducing the no. of terms in the expression .

***EX***: Prove that A.B = A+B

Sol: A.B = A+B = A+B

***EX***: Simplify the following :

 Z=A(A+B)

Sol: Z = AA+AB = A+AB = A

***EX***: write the Boolean exp. For the following circuit

 A

 B

 C Z

Sol: Z = (A+B).C

***EX***: write the Boolean exp. For the following logic cct. :

 A

  Z

 B

Sol : Z = AB+AB = A ⊕ B

***EX***: write Boolean exp. For the following logic cct. :

 A

B

Z

C

Sol: Z = (AB+AB).C =(A ⊕ B).C

**NOTE :** The priorities of logic operation are :

 ( )

 AND

 OR

***EX***: Construct the logic circuit for the following Boolean exp. :

 Z = A.B+B

Sol:

 We need 2-input AND gate A

 B  2-input OR gate

 2-inverters Z

***EX***: Construct the logic cct. , and write the T.T. for the following logic eq.

 Z = AC+ABC

 ABC Z

Sol: 000 0

 A  001 0

 C  Z 010 0

 011 0

 B 100 0

 101 1

 110 0

 111 1

***Ex*:** simplify the following :

A= x y z + x y z + x y z + x y z =x z (y+y) + x z (y+y) = x z +x z = z (x+x) = z

***Ex:*** simplify the following :

Z= AB + A(B+C) + B(B+C)

 = AB + AB + AC + BB + BC

 = AB + AC + B + BC

 = AB + AC + B

 = B + AC

***Ex:*** Simplify the following :

Z = ABC + ABC + ABC

 = ABC + AC(B+B)

 = ABC + AC

 =C (AB+A)

 =C (A+B)

 =CA+CB

***Ex***: Simplify the following using Boolean Algebra

F= A{ BC(A+B+C+D)}

 = ABC(A+B+C+D)

 =ABCA +ABCB +ABCC +ABCD

 =ABC+ABC+ABC+ABCD

 =ABC+ABCD

 =ABC(1+D)

 = ABC

***EX***: Simplify:

F = AC + ABC + ACD + CD

 = A(C+BC) + C(AD+D)

 = A(C+B)+C(A+D)

 = AC + AB + CA +CD

 = A(C+C) + AB + CD

 = A + AB +CD

 = A(1+B) + CD

 = A + CD

***EX***: Prove that :

F= ABC + ABC + ABC = A(B+C)

 = AC(B+B) + ABC

 = AC + ABC

 = A(C+BC)

 = A(C+B)

***EX***: Simplify :

 X = AB + ABC + AB + ABC

 = AB(1+C) + AB + ABC

 = AB + AB + ABC

 = B + ABC

 = B + BAC

 = B + AC

***EX***: In a 3-input cct. The output is (1) if the majority of input is (1) , and otherwise , it is zero. White the T.T. for this cct. :

 ABC Z

 000 0

 001 0

 010 0

 011 1

 100 0

 101 1

 110 1

 111 1