Ch- Mathematical logic

☆ Logic gates :-

① AND :- (Conjunction) (Aswell as , but, neither, nor ...)
It is denoted by '$\wedge$'

p :- 2 is an even number
q :- Newton ~~is~~ was my neighbour

Statement :- $p \wedge q$
2 is an even number but newton was my ~~neigbo~~ neighbour.

Truth table

p	q	$p \wedge q$
T	T	T
T	F	F
F	T	F
F	F	F

y,
$T \wedge T \equiv T$
otherwise $\equiv F$

② OR :- (disjunction) (either ..... or)
It is denoted by '$\vee$'
Symbolic form :- $p \vee q$

Truth table :-

p	q	$p \vee q$
T	T	T
T	F	T
F	T	T
F	F	F

y,
$F \vee F \equiv F$
otherwise $\equiv T$

(3) If .... then (Conditional / Implication)

Symbol :- $\longrightarrow$ / $\Rightarrow$

Truth table

p	q	$p \rightarrow q$
T	T	T
T	F	F
F	T	T
F	F	T

If, $T \longrightarrow F \equiv F$

otherwise, $\equiv T$

(4) If and only if :- (Biconditional / Double implication) :-

Symbol :- $\longleftrightarrow$

Truth table

p	q	$p \leftrightarrow q$
T	T	T
T	F	F
F	T	F
F	F	T

If, $\left.\begin{matrix} T \leftrightarrow T \\ F \leftrightarrow F \end{matrix}\right\} \equiv T$

otherwise, $\equiv F$

(5) NOT :- (Negation)

Symbol :- $\sim$

p	$\sim p$
T	F
F	T

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☆ Types of Statement:-

① Compound Statement:-

A Statement in which logical connectives appears is called compound or composite statement.

② Simple Statement :-

A statement in which no logical connectives appears is called simple or atomic statement.

☆ Quantifiers

These are the phrases which are used to convert open sentences into statement.

i) Universal quantifier : It is denoted by '$\forall$'
This belongs to 'ALL' and 'EVERY'.

ii) Existential quantifier:- It is denoted by '$\exists$'.
This belongs to 'some', 'few' and 'there exist atleast 1'.

☆ Duals:-

Duals of statement is obtained by interchanging $\wedge$ with $\vee$, $\vee$ with $\wedge$, t with c & T with F.

Note: All the above changes are obtained without changing the negation sign.

☆ Converse, Inverse and contrapositive of conditional statement:-

$$p \longrightarrow q$$

Converse:- $q \longrightarrow p$

Contrapositive :- $\sim q \longrightarrow \sim p$

Inverse :- $\sim p \longrightarrow \sim q$

☆ Negation of Compound Statement:-

① Negation of Conjunction:-

$$\sim(p \wedge q) \equiv \sim p \vee \sim q$$

② Negation of disjunction:-

$$\sim(p \vee q) \equiv \sim p \wedge \sim q$$

③ Negation of ~~discon~~ implication:-

$$\sim(p \rightarrow q) \equiv \cancel{p \rightarrow \sim q} \;\; p \wedge \sim q$$

④ Negation of double implication:-

$$\sim(p \leftrightarrow q) \equiv (p \wedge \sim q) \vee (q \wedge \sim p)$$

⑤ Negation of Negation:-

$$\sim(\sim p) \equiv p$$

⑥ Negation of Quantifiers:-

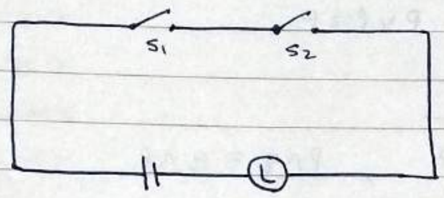
ALL $\longleftrightarrow$ Same

($\forall$) ($\exists$)

AND	$\wedge$	$\cdot$
OR	$\vee$	$+$

☆ Switching circuits

① Series combination:-



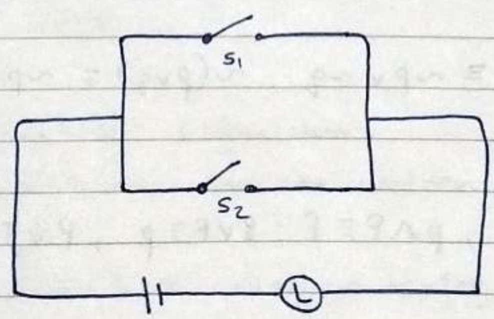
p:- switch S_1
q:- switch S_2
L:- Lamp

Symbolic form:- $p \wedge q$

Input table

p	q	table
1	1	1
1	0	0
0	1	0
0	0	0

② Parallel Combination:-



p : Switch S_1
q: Switch S_2
L: Lamp
Symbolic form:- $p \vee q$

Input output Table:-

p	q	$p \vee q$
1	1	1
1	0	1
0	1	1
0	0	0

~~Ideppot~~

Idempotent law:-

$p \wedge p \equiv p$, $p \vee p \equiv p$

Commutative law:-

$p \vee q \equiv q \vee p$, $p \wedge q \equiv q \wedge p$

Associative law:-

$p \wedge (q \wedge r) \equiv (p \wedge q) \wedge r \equiv p \wedge q \wedge r$

$p \vee (q \vee r) \equiv (p \vee q) \vee r \equiv p \vee q \vee r$

Distributive law

$p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$

$p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$

Demorgan's law:

$\sim(p \wedge q) \equiv \sim p \vee \sim q$, $\sim(p \vee q) \equiv \sim p \wedge \sim q$

Identity law:

$p \wedge T \equiv p$, $p \wedge F \equiv F$, $p \vee F \equiv p$, $p \vee T \equiv T$

Complement law:

$p \wedge \sim p \equiv F$, $p \vee \sim p \equiv T$

Absorption law:

$p \vee (p \wedge q) \equiv p$ $p \wedge (p \vee q) \equiv p$

Conditional law: $p \longrightarrow q \equiv \sim p \vee q$

Biconditional law: $p \longleftrightarrow q \equiv (p \longrightarrow q) \wedge (q \longrightarrow p)$

$\equiv (\sim p \vee q) \wedge (\sim q \wedge p)$