MATHEMATICAL REASONING

1. **Statements:** A statement is a sentence which either true or false, but not both simultaneously.

2. **Negaiton of a statement**: The denial of a statement *p* is called its negation, written as ~ *p*.
   Negation of any statement p is formed by writing " It is not the case that ..... " or " It is false that....." before *p* or, if possible by inserting in *p* the word "not".

3. **Compound statement**: We have learnt about negation of a simple statement. Writing the negation of compound statements having conjunction, disjunctions, implication, equivalence, etc, is not very simple. So, let us discuss the negation of compound statement. The Compound statements are made by:
   (i) **Connectives**: "AND", "OR"
   (ii) **Quantifiers**: "There exists", "For every"
   (iii) **Implications:** The meaning of implications "If ", "only if ", " if and only if ".

(a) "p ⇒ q" : p is sufficient condition for q or p implies q.
q is necessary condition for p.
The converse of a statement p ⇒ q is the statement q ⇒ p.
p ⇒ q together with its converse, gives p if and only if q.

(b) "p ⇔ q"

A sentence with if p, then q can be written in the following ways.

p implies q (denoted by $p \Rightarrow q$)

p is a sufficient condition for q

q is a necessary condition for p

p only if q

$\sim q$ implies $\sim p$

4. **Contrapositive**: The contrapositive of a statement $p \Rightarrow q$ is the statement $\sim q \Rightarrow \sim p$.

5. **Contradiction:** A statement pattern is called a contradiction, if it is always false, whatever may the truth values of its constitute statements. In the last column of the truth table of contradiction there is always *F*.

6. **Validating statements**: Checking of a statement whether it is true or false. The validity of a statement depends upon which of the special.

   The following methods are used to check the validity of statements:

   (i) direct method

   (ii) contrapositive method

   (iii) method of contradiction

   (iv) using a counter example.