

## 12. Set Theory

The set which does not contain any element is known as an empty set.

If every point of a set  $A$  belongs to  $B$ , then  $A$  is contained or included in  $B$  and is a subset of  $B$ , while  $B$  is known as the superset of  $A$ . This is represented as  $A \subset B$  or  $B \supset A$ .

Two sets are identical if they contain exactly the same points, and is then denoted as  $A=B$ .

Another way to represent this is:  $A = B$  if and only if  $A \subset B$  and  $B \subset A$ .

Two sets are said to be equivalent if they contain the same number of elements.

The set  $A - B$  is the set of all those elements that belong to  $A$ , but not  $B$  and is called the

Difference set.

The set  $A \Delta B$  is the set of all those elements that belong to either A or B, but not both. It is called the symmetric difference set.

$$A \Delta B = (A \cup B) - (A \cap B).$$

$$A \Delta B = (A - B) \cup (B - A).$$

Empty set is a subset of every set.

Every set is a subset of itself.

The set of all subsets of a set is called the power set. It contains  $2^n$  elements, if the original set contains n elements.

In  $A \cup B$ , the max value of the intersection  $A \cap B$  is the min of  $n(A)$  and  $n(B)$ .

In  $A \cup B \cup C$ , the maximum value of the intersection  $A \cap B \cap C$  is the minimum of the intersections  $A \cap B$ ,  $B \cap C$  and  $A \cap C$ .

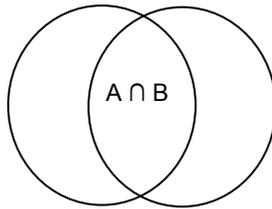
De Morgan's laws –

$$1. (A \cap B)^C = A^C \cup B^C.$$

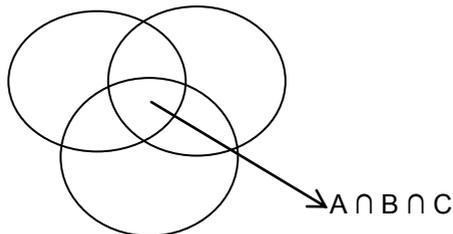
$$2. (A \cup B)^C = A^C \cap B^C.$$

## Operations With Venn Diagrams

- The union  $A \cup B$  of two sets  $A$  and  $B$  is the set of points, which belong to at least one of them.
- The intersection of sets  $A \cap B$  of two sets  $A$  and  $B$  is the set of points which belong to both of them.
- The union of two sets,  $A \cup B = A + B - A \cap B$



The union of three sets  $A \cup B \cup C = A + B + C - (A \cap B + B \cap C + C \cap A) + (A \cap B \cap C)$



It is very important here to understand the

## meaning of certain terms.

- **At least 1:** means min. 1 i.e. 1 or more than 1.
- **At least 2:** means min. 2 i.e. 2 or more than 2.
- **At The Most 2:** means maximum 2 i.e. 2 or less than 2.
- **At the most 3:** means maximum 3 i.e. 3 or less than 3.