

**Fallacy** : This is statement which is false for all truth values of its components. It is denoted by f or c. Consider truth table of  $p \wedge \sim p$

p	$\sim p$	$p \wedge \sim p$
T	F	F
F	T	F

(i)	Statements	$p \wedge q$	$p \vee q$	$p \rightarrow q$	$p \leftrightarrow q$
	Negation	$(\sim p) \vee (\sim q)$	$(\sim p) \wedge (\sim q)$	$p \wedge (\sim q)$	$p \leftrightarrow \sim q$

(ii)	Let $p \Rightarrow q$ Then (Contrapositive of $p \Rightarrow q$ ) is $(\sim q \Rightarrow \sim p)$
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## SETS AND RELATION

**Laws of Algebra of sets (Properties of sets):**

- (i) **Commutative law** :  $(A \cup B) = B \cup A$  ;  $A \cap B = B \cap A$
- (ii) **Associative law**:  $(A \cup B) \cup C = A \cup (B \cup C)$  ;  $(A \cap B) \cap C = A \cap (B \cap C)$
- (iii) **Distributive law** :  
 $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$  ;  $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$
- (iv) **De-morgan law** :  $(A \cup B)' = A' \cap B'$  ;  $(A \cap B)' = A' \cup B'$
- (v) **Identity law** :  $A \cap U = A$  ;  $A \cup \phi = A$
- (vi) **Complement law** :  $A \cup A' = U$ ,  $A \cap A' = \phi$ ,  $(A')' = A$
- (vii) **Idempotent law** :  $A \cap A = A$ ,  $A \cup A = A$

**Some important results on number of elements in sets :**

If A, B, C are finite sets and U be the finite universal set then

- (i)  $n(A \cup B) = n(A) + n(B) - n(A \cap B)$
- (ii)  $n(A - B) = n(A) - n(A \cap B)$
- (iii)  $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(A \cap C) + n(A \cap B \cap C)$
- (iv) Number of elements in exactly two of the sets A, B, C  
 $= n(A \cap B) + n(B \cap C) + n(C \cap A) - 3n(A \cap B \cap C)$
- (v) Number of elements in exactly one of the sets A, B, C  
 $= n(A) + n(B) + n(C) - 2n(A \cap B) - 2n(B \cap C) - 2n(A \cap C) + 3n(A \cap B \cap C)$

## Types of relations :

In this section we intend to define various types of relations on a given set A.

**(i) Void relation :** Let A be a set. Then  $\phi \subseteq A \times A$  and so it is a relation on A. This relation is called the void or empty relation on A.

**(ii) Universal relation :** Let A be a set. Then  $A \times A \subseteq A \times A$  and so it is a relation on A. This relation is called the universal relation on A.

**(iii) Identity relation :** Let A be a set. Then the relation  $I_A = \{(a, a) : a \in A\}$  on A is called the identity relation on A. In other words, a relation  $I_A$  on A is called the identity relation if every element of A is related to itself only.

**(iv) Reflexive relation :** A relation R on a set A is said to be reflexive if every element of A is related to itself. Thus, R on a set A is not reflexive if there exists an element  $a \in A$  such that  $(a, a) \notin R$ .

**Note :** Every identity relation is reflexive but every reflexive relation is not identity.

**(v) Symmetric relation :** A relation R on a set A is said to be a symmetric relation

iff  $(a, b) \in R \Rightarrow (b, a) \in R$  for all  $a, b \in A$ .      i.e.  $a R b \Rightarrow b R a$  for all  $a, b \in A$ .

**(vi) Transitive relation :** Let A be any set. A relation R on A is said to be a transitive relation

iff  $(a, b) \in R$  and  $(b, c) \in R \Rightarrow (a, c) \in R$  for all  $a, b, c \in A$   
i.e.  $a R b$  and  $b R c \Rightarrow a R c$  for all  $a, b, c \in A$

**(vii) Equivalence relation :** A relation R on a set A is said to be an equivalence relation on A iff

(i) it is reflexive i.e.  $(a, a) \in R$  for all  $a \in A$

(ii) it is symmetric i.e.  $(a, b) \in R \Rightarrow (b, a) \in R$  for all  $a, b \in A$

(iii) it is transitive i.e.  $(a, b) \in R$  and  $(b, c) \in R \Rightarrow (a, c) \in R$  for all  $a, b, c \in A$