# 1.5 Laws of algebra of sets

(1) **Idempotent laws:** For any set $A$, we have

(i) $A \cup A = A$ (ii) $A \cap A = A$

(2) **Identity laws:** For any set $A$, we have

(i) $A \cup ¤ = A$ (ii) $A \cap U = A$

*i.e.*, ¤ and $U$ are identity elements for union and intersection respectively.

(3) **Commutative laws:** For any two sets $A$ and $B$, we have

(i) $A \cup B = B \cup A$ (ii) $A \cap B = B \cap A$

(iii) $A \Delta B = B \Delta A$

*i.e.*, union, intersection and symmetric difference of two sets are commutative.

(iv) $A - B \neq B - A$ (v) $A \times B \neq B \times A$

*i.e.*, difference and cartesian product of two sets are not commutative

(4) **Associative laws:** If $A$, $B$ and $C$ are any three sets, then

(i) $(A \cup B) \cup C = A \cup (B \cup C)$ (ii) $A \cap (B \cap C) = (A \cap B) \cap C$

(iii) $(A \Delta B) \Delta C = A \Delta (B \Delta C)$

*i.e.*, union, intersection and symmetric difference of two sets are associative.

(iv) $(A - B) - C \neq A - (B - C)$ (v) $(A \times B) \times C \neq A \times (B \times C)$

*i.e.*, difference and cartesian product of two sets are not associative.

(5) **Distributive law:** If $A$, $B$ and $C$ are any three sets, then

(i) $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$

(ii) $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$

*i.e.*, union and intersection are distributive over intersection and union respectively.

(iii) $A \times (B \cap C) = (A \times B) \cap (A \times C)$

(iv) $A \times (B \cup C) = (A \times B) \cup (A \times C)$

(v) $A \times (B - C) = (A \times B) - (A \times C)$

(6) **De-Morgan's law:** If $A$, $B$ and $C$ are any three sets, then

(i) $(A \cup B)' = A' \cap B'$

(ii) $(A \cap B)' = A' \cup B'$

(iii) $A - (B \cap C) = (A - B) \cup (A - C)$

(iv) $A - (B \cup C) = (A - B) \cap (A - C)$

(7) If $A$ and $B$ are any two sets, then